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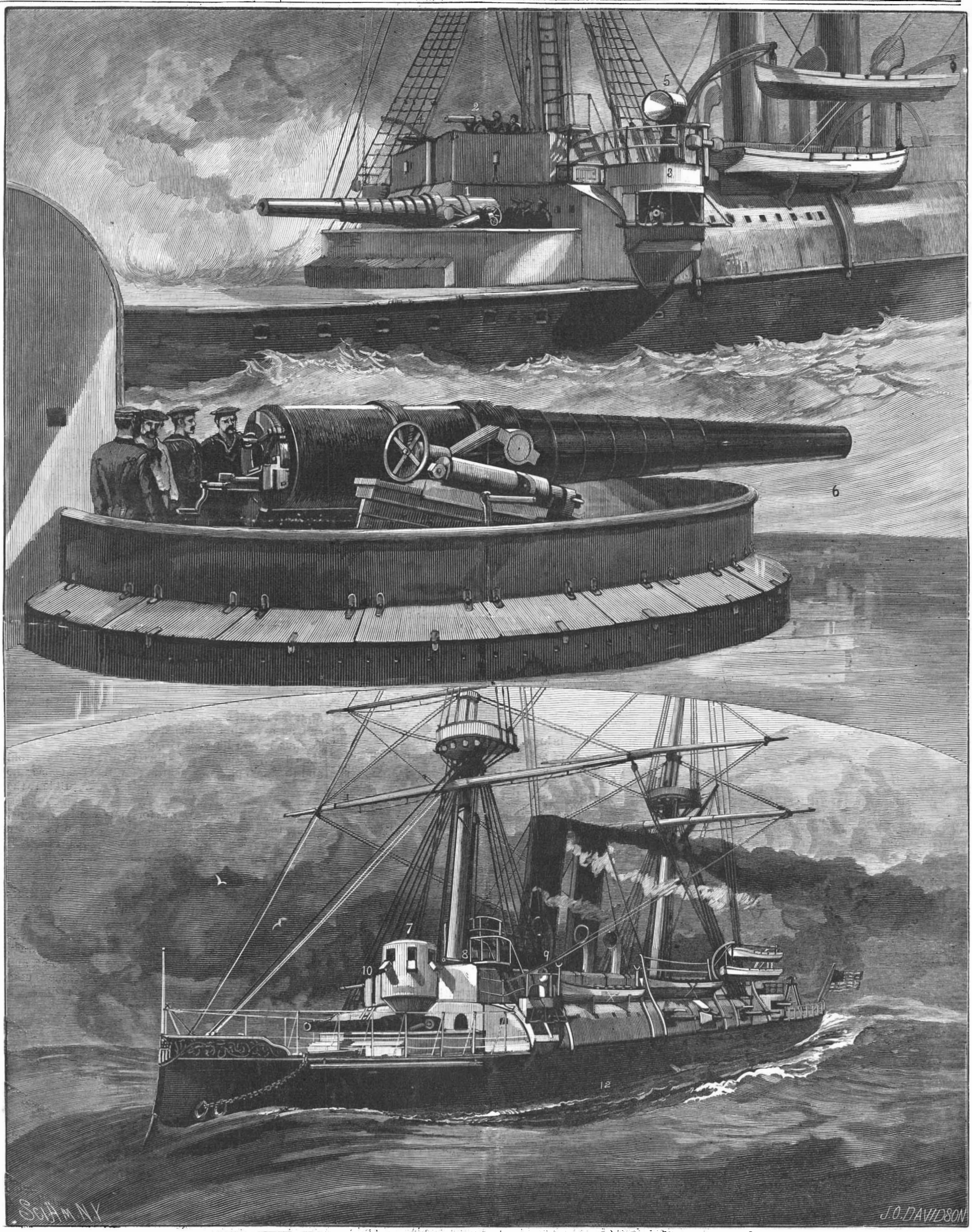

THE NEW NAVY—SKETCHES ON THE CRUISER ATLANTA.—[See page 321.]

1. Stern Chase 8 in. Breech-loading Rifle. 2. Gatling Gun. 3. Hotchkiss Tower and Single Shot 3 lb. 47 mm. Machine Gun. 4. Gatling Gun. 5. Search Light. 6. 8 in. Long Range Breech-loading Rifle, Forward Deck. 7. Armored Pilot House. 8. Gatling Gun. 9. Search Light. 10. 37 mm. Gatling Gun. 11. 6 in. Breech-loading Broadside Rifles. 12. Wave Line at Full Speed.

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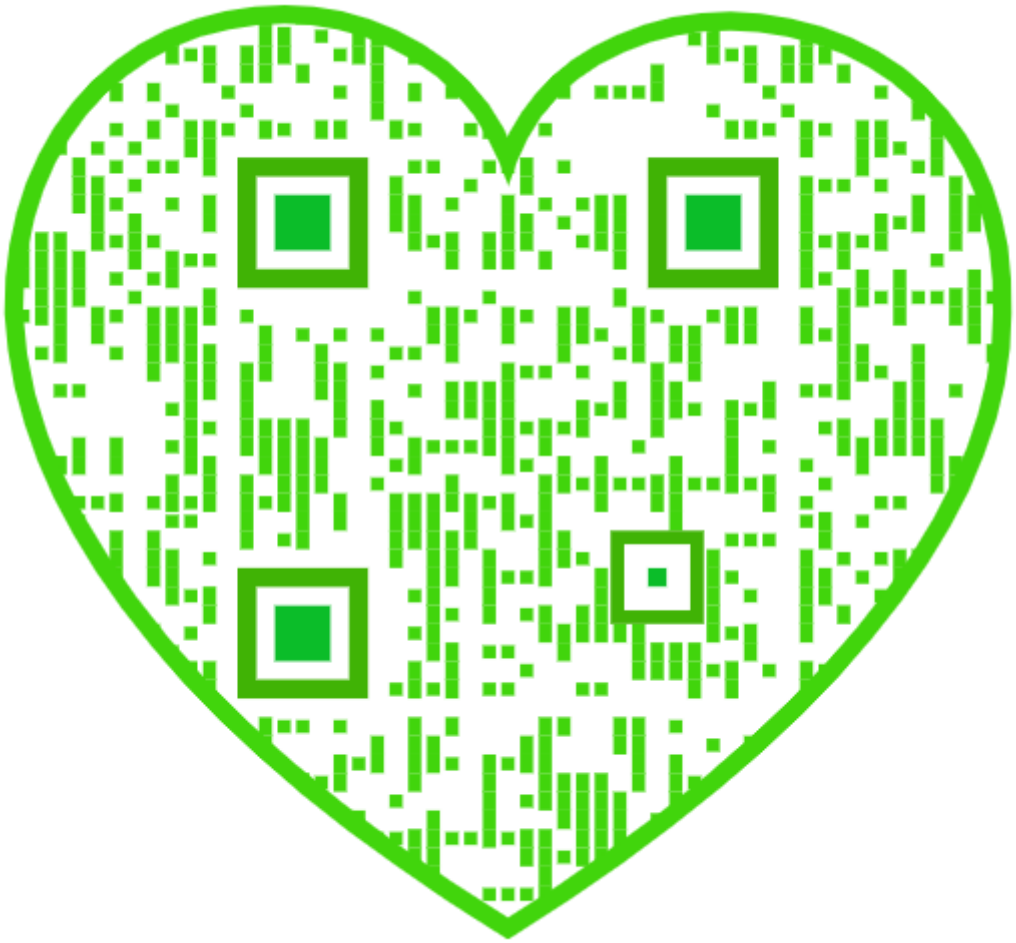

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NEW YORK, SATURDAY, MAY 21, 1887.

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THE MAGAZINE GUN AS A MILITARY ARM.

Military authorities are by no means agreed that the magazine rifle is superior to the breech-loader for the use of the soldier; and though Europe is hurriedly exchanging the former for the latter, the voice of indignant protest is making itself heard in the military journals, and with no uncertain sound. Who does not remember the *zundnadelgewehr*, or needle gun, and the great victory it won at Koniggratz (Sadowa), where, after a campaign of only forty days, the finest army Austria ever set afield was hopelessly beaten?

Though one of the first captains in Europe, Gen. Benedeck was no match for "Gen. Needlegun." This was in 1866. In 1870, the needle gun had another triumph, and backed by discipline and the power of rapid mobilization, it proved too much even for the much vaunted chassepot and mitrailleuse. Remembering what has been done by the needle gun, it is not surprising that there should be strong opposition to its withdrawal in favor of a successor of uncertain utility. At the first blush, it would seem as if a gun capable of being fired a dozen or more times without reloading ought to take precedence over one which must be reloaded after every discharge. Theoretically, it has a great advantage over the single firer; but as a military arm, to be used in the heat and amid the excitement of battle, there is a firm belief in some quarters that it will be found wanting. In some recent articles and letters in our German contemporary, the *Militar Wochenblatt,* the defects of the magazine gun as a military arm have been carefully pointed out; and while they have doubtless occurred to every one who is at all familiar with the school of the soldier and the art of war, it is interesting, in the light of present events, to review them.

The friends of the new arm, "M. 71–86," like to point out that it is the old, reliable "Mauser" single-loader fitted with a magazine; but the mechanism of the old gun is simple, and of the present one complex.

It is not necessary for us, following our German contemporary, to discuss the imminency of another Franco-German war and the consequent danger of adopting an arm which requires familiarity with new tactics. It is enough for the present purpose to look only at the possible relative advantages of the magazine and single firing gun. Even under the most favorable conditions, the magazine gun changes its range after each fire, because it is lighter by the weight of the fired cartridge. It is, of course, evident that, in the hands of a skillful man, a cool and intelligent man, the magazine gun is a powerful weapon. But the average soldier, especially him from the rural districts, is awkward, stupid, and excitable. Once let him get to work on the lever of the magazine gun, and it is ten to one he fires every shot in his magazine regardless of range, or breaks the lever; and if, as is likely, it should prove difficult to restrain his ardor, the quick handling of troops, change of front, and the like might be seriously impeded.

Whoever may have followed the various trials that have been made with the magazine gun in the hands of the common soldier, or at least those few which have been published, can scarcely fail of surprise that the great powers, one and all, should have decided to adopt it. Of course, it is to be expected that continual handling will bring a certain amount of precision; but in these days of great armies, when a million men are set afield by a single power, it is necessary to count the cost of learning to use a new weapon, and to learn whether or no it may be relied upon in times of excitement, when roughly and awkwardly handled. It was only a few weeks ago when the 132d of the line had a trial with the magazine gun. Now, this corps is to the general staff of the German army what the Black Watch is to the English army, what the Old Guard was to Napoleon, and the Tenth Legion to Cæsar. They fired over the target, and under it, and to one side of it, and, as if there was no such thing as keeping anything like a range, they no sooner refilled their magazines and started again, than the same observed differences were recorded. If the target could have fired back, even with single loaders, there would not have been any hope for them. Surely, if whole corps practicing at the butts with single firers had exhausted ammunition in this reckless way, we should long since have been compelled to establish powder factories for each regiment, or go back to the crossbow and the sling.

THE CELESTIAL WORLD.

THE CONJUNCTION OF VENUS AND SATURN.

The near approach of two large planets is a noteworthy event on astronomical annals. Such an event occurs on the 30th of May, at noonday, when Venus and Saturn are at their nearest point, Venus being 2° 15′ north of Saturn.

The planets are invisible to the naked eye at the time of conjunction, but powerful telescopes will bring them out even in the full sunlight. The western sky, however, will present a charming picture on the evenings of the 29th and 30th. Venus, the largest and most beautiful star that shines in the sky, is as easily recognized as the sun or moon. Saturn may be easily found by means of the two first magnitude stars, Castor and Pollux, a few degrees north of the planet. On the 29th Saturn will be east of Venus, and on the 30th he will be found on the west of his brilliant rival.

The reason for the meeting and parting of the two planets may be easily explained. Venus is an inferior or inner planet, and as seen from the earth is moving eastward or from the sun. Saturn is a superior or outer planet, and seems to be moving westward or toward the sun. When two planets are traveling, the one toward the east, like Venus, and the other toward the west, like Saturn, unless there be a change in their course, they must meet and pass on the celestial road. There comes a point when they are in the same right ascension or longitude. This condition of affairs takes place on the 30th, and the planets are then said to be in conjunction.

It is not only a pleasing spectacle to behold the queen of the stars and the ringed wonder of the skies in near proximity, but the interest of the meeting is increased by the near neighborhood of the stars Castor and Pollux. The beaming planets and two first magnitude stars form a rare picture of planetary and starry beauty, the shining quartet illustrating the contrast between inherent and reflected light.

The moon in her first quarter will add her soft light to the starry show, and the exhibition will continue until 10 o'clock, when the planets will slowly disappear behind the western hills.

It will be almost equally interesting to watch the planets as they approach each other before the 30th or as they recede from each other after the 30th.

THREE PLANETS VISIBLE IN VIRGO.

Jupiter, Uranus, and the asteroid Vesta are now in the constellation Virgo, and are all visible to the naked eye. An observer glancing at the eastern sky in the early evening will behold Jupiter in his most superb aspect as he slowly rises with stately step toward the meridian, holding as prominent a place in the east as Venus holds in the west. It will not be as easy to find his two companions with the unaided eye, and an opera glass will be an efficient aid in pointing out their position. But the feat may be accomplished if the moon be out of the way, the sky cloudless, the atmosphere pure, and the star-gazer possessed of good visual power. The bright star west of Jupiter is Spica. The distance between star and planet on the last of May is about 5°, which will be a guide in celestial measurement.

Uranus, the second star of the trio, may be looked for about 20° northwest of Jupiter and a little more than 2° south of the third magnitude star Gamma Virginis. Vesta may be found about 12° north of Jupiter and a few degrees northeast of the third magnitude star Zeta Virginis.

Uranus and Vesta shine as stars of the sixth magnitude, the smallest stars perceptible to the naked eye. Vesta is the largest of the family of 265 asteroids, and the only one visible to the unaided eye. She is less than 500 miles in diameter and yet looks to terrestrial observers as large as the giant planet Uranus, who is more than 31,000 miles in diameter. The great difference in the distance is the reason why the planets appear to be of the same size. Vesta circles round the sun at a mean distance of 230,000,000 miles, while Uranus makes his vast circuit at a distance of more than 1,800,000,000 miles. Therefore the tiny asteroid and the huge planet appear to mortal eyes of the same size. Both are shining points barely perceptible to the eye.

Jupiter, Vesta, and Uranus form an isosceles triangle, or one that is nearly so, of which Jupiter and Vesta are the base and Uranus is the summit.

A New System of Boot Making.

The London (Eng.) *Shoe and Leather Record* describes a system of fastening the soles to boots and shoes, in which the fastenings are driven from the inside, the fastenings being first placed in the insole and then the upper lasted over them. The fastening is of brass, with a conical front, barbed all around the point, and the head is flat and neatly formed. A machine is used to feed and drive the fastenings at regular distances through the insole. The insole is then laid on the last, with the barbed points standing erect. The upper is lasted over these points and pushed down, leaving sufficient of the point still above the upper to pierce half way through the sole. The sole is then laid on as though upon blinders, hammered down, and the process is complete. The heeling and finishing are performed in the ordinary way.

THE A. A. GRIFFING IRON CO., of Jersey City, N. J., have issued a handsome illustrated catalogue of the Bundy patent radiators, which they make in so many sizes and styles, and in such great quantities, that it requires a very extended manufacturing plant to enable them to keep up with the demand. The facsimile testimonials and lists of users of these radiators given in this volume, as to the excellence and efficiency of this method of heating, render further commendation simply superfluous.

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The Hudson River Tunnel.

After a resting spell of four and a half years, this great undertaking has been again opened, and one of the headings is being extended as rapidly as possible through the bed of the Hudson. Although all of the four headings will be worked simultaneously, the principal endeavor will be to complete and open the north tunnel, which is about one-third finished. The method of building the tunnel has not been changed. Compressed air is relied upon to keep the heading free from water, and the tenacity of the wall of silt is depended upon to separate the air and water. The heading is excavated as fast as the plate sheathing and masonry can be put in, while the pilot is kept from fifteen to twenty feet in advance of the heading, and thus serves as an explorer into the nature of the material ahead.

The work is of decided interest from an engineering point of view, as it introduces and, what is more important, practically tests a new and novel system of tunneling, which, so far at least, has proved to be efficient and economical. The tunnels once completed will be invaluable to the commerce of this city, as they will provide sure and rapid connection with all the great railroads terminating on the west side of the Hudson River, opposite this city.

We understand that all the capital necessary has been secured, and that all financial stumbling blocks have been removed. We congratulate Mr. D. C. Haskin, the inventor of the system employed in the tunneling, upon his indomitable energy and perseverance in surmounting the many difficulties he has encountered, and hope that his anticipations in respect to the result of his grand engineering enterprise will be fully realized.

Elsewhere in this issue will be found a description with illustration of this great work from its inception up to the present time.

Printing Plates from Photographs.

A method of reproducing photographs in copper plate, lithographic, or printing presses has been realized by Capt. Louis Collardon, of Cordoba, Buenos Ayres. The relief surface for the photographs is a specially prepared surface of gypsum, which is composed of 1 to 6 per cent chalk and 50 per cent water to each 100 parts gypsum, the latter, together with the chalk, being finely powdered and well worked with the water to obtain a homogeneous mass, which is then pressed into plates of suitable size, having a polished surface when dry. The pigment paper is prepared as follows: Common black pigment paper is placed in a bath composed of 4 per cent bichromate of potash to 100 per cent water for from one to five minutes, as required, and then dried in a temperature of 60 deg. to 70 deg. C. The paper is then exposed to the daylight for from ten minutes to two hours, according to the strength of the light, and then placed in cold water for about an hour, and then in another bath composed of about 6 per cent pyrogallic acid to 100 per cent alcohol for about ten minutes, when it is placed in a frame or on a plate and dried. As soon as completely dry, it is covered with powdered oxide of zinc or oxide of bismuth, which is rubbed in with the palm of the hand, thus pressing it into the deep parts, and leaving the upper parts or lines of the figures free, the surplus powder being removed. The pigment paper thus prepared is placed in front of the camera, and a negative produced in the usual way. This negative is removed from the glass and placed between the negative of the photo. to be reproduced and a pigment paper, which has been prepared with a strong solution of gelatine containing only a small quantity of pigment, and then copied as usual, thereby producing a positive on the pigment paper with the same irregular surface as that on the negative, which is necessary to print from. The printing block is prepared as follows:

The gypsum plate is placed under water, and upon it the positive, also under water, then the plate with the positive is removed from the water, and the positive pressed against the plate by an India rubber roller or squeezer to remove any air that may be between, the positive closely adhering to the plate. It is then pressed slightly in a press, and then placed in a bath composed of water and 10 per cent sulpho-cyanide of ammonium, which will dissolve those parts which are not or only partially developed. When removed from this bath and washed in cold water, it is placed in a bath composed of 5 per cent chrome alum in water for about five minutes, then removed and washed, and immersed in a bath of concentrated alcohol and dried, and then impressed into a plastic mass composed of bone dust, albumen, blood, and silicate of soda, the proportions depending on the hardness required. Any other plastic substance may be used, such as celluloid, cyanoid, etc., by means of a hydraulic press or other suitable means, steam being introduced during the operation. When cold, it is removed from the press.

THE great war ship built under the name Renown by Messrs. Armstrong, Mitchell & Co. for the British navy was launched recently, and named the Victoria in honor of the Queen's 50th year of reign. Her length is 340 ft., breadth 70 ft., mean draught 26 ft. 9 in., displacement 10,500 tons, and horse power 12,000.

STEAM CRUISER ATLANTA, U. S. N.

In 1883 the government entered into contract with the late John Roach for the building of the twin screw steam cruiser Chicago, single screw steam cruisers Boston and Atlanta, and the dispatch boat Dolphin, the construction of which had been authorized by act of Congress. The contract price for all the vessels was $2,440,000, which included the hull, machinery, and fittings, but excluded the masts, spars, sails, etc. In the SCIENTIFIC AMERICAN SUPPLEMENT, No. 432, may be found accurate and spirited sketches of each of these boats, together with a description of their principal features.

The accompanying frontispiece illustrates the Atlanta, which now lies, complete and perfect in every detail, at the Brooklyn Navy Yard. The other three boats are finished as regards their machinery and hulls, but have not yet received their armaments.

The principal dimensions of the Atlanta are as follows:

Length between perpendiculars	270 ft.
" on water line	276 "
" over all	283 "
Extreme breadth	42 "
Mean draught at load water line	16 " 10 in.
Displacement at water line	3,000 tons.
Sail area	10,400 sq. ft.
Indicated horse power	3,500
Speed at sea	13 knots.
Capacity of coal bunkers	580 tons.

The ship is built of steel, and is divided into nine main compartments by eight complete transverse bulkheads, extending to the main deck. The boilers and machinery are protected by a coal armor 8 feet thick above the water line and 5 feet below, the coal bunkers being formed by longitudinal bulkheads extending on each side through the machinery space. The doors closing the compartments can be operated from below or from the main deck. In addition to the 580 tons of coal carried by the bunkers, about 200 tons more can be taken on board if necessary, thus enabling the vessel to steam 2,500 miles at full speed, or 5,300 miles at the rate of 10 knots an hour. For 100 feet the machinery spaces are protected by a steel deck, one inch and a half thick, and at the bottom of these spaces is a water-tight double bottom, containing twelve water-tight cells. The outside plating is 23 pounds to the square foot, and is doubled from the stem to near the stern at the water line.

The motive power consists of a three cylinder compound horizontal engine of 3,500 horse power; the high pressure cylinder is 54 inches in diameter and the two low pressure 74 inches, the latter being arranged at either side of the former, and the stroke is 42 inches. The steel shaft is 16 inches in diameter at the journals, and is made in three interchangeable sections. The low pressure cranks are set at right angles, while the other is placed between the two at angles of 135 degrees. The screw is four bladed, 17 feet in diameter, and has a pitch of 20 feet. Steam is supplied by eight horizontal return tubular boilers, located forward of the engine, and separated into two groups by a transverse bulkhead. Each boiler is 9¾ feet long, 11 2-3 feet in diameter, and is provided with two cylindrical furnaces having a grate surface of 25 square feet. A forced draught is obtained from six blowers, each having a capacity of 12,000 cubic feet per minute, which creates an air pressure in the air-tight boiler room equal to one or two inches of water. The boilers were tested to 160 pounds.

From the accompanying engravings a comprehension idea may be obtained of the disposition of the battery. 1 is a stern chase 8 in. breech-loading rifle, 2 a Gatling gun, 3 a Hotchkiss tower and single shot 3 lb. 47-millimeter gun, 4 Gatling machine gun, 5 search light, 6 8 in. long range breech-loading rifle on forward deck, 7 armored pilot house, 8 Gatling gun, 9 search light, 10 37-millimeter Gatling gun, 11 broadside breech-loading 6 in. rifle. At 12 the remarkably perfect wave line of the ship at full speed is shown.

The first trial trip of this boat was from the Brooklyn Navy Yard up the Sound and back, when some trouble was experienced with the water relief valves of the high pressure cylinder and with the heating of the thrust bearing. The second trip was to Newport to adjust the compasses, and the bearing again heated. Upon the return this bearing was entirely overhauled, when it was found that the rings had not been properly fitted, and the pressure brought upon them was, consequently, unevenly distributed. After having been carefully refitted, the third and last trip was made, the vessel leaving the Navy Yard at seven in the morning, and running continuously until seven in the afternoon, the course being out to sea and return. The pressure in the fire rooms ranged from 1·1 to 1·5 in. of water, the steam pressure in the engine room averaged 88 pounds, and the vacuum 26 in. The average speed attained was $15\frac{15}{100}$ knots for six hours, the maximum being $16\frac{33}{100}$. The maximum indicated horse power was 3,506. The boiler pressure varied from 94 to 96 pounds, the safety valve being set to blow off at 100. The shaft made an average of 68 revolutions per minute.

During the entire trip the engines were not stopped, and no trouble whatever was occasioned by any part of the machinery, everything worked easily, smoothly, and satisfactorily. The vessel itself gave evidence of great strength and rigidity.

Previous to this the wrist pin of the high pressure crank had heated more or less, the lubrication being imperfect, owing to the oil being thrown out by the rapid revolution. This was perfectly remedied by providing the bearing with a telescope oil cup, one of which will now be placed upon each of the other wrist pins.

The tests of this cruiser have resulted most satisfactorily, and her engines have developed the full power called for in the specifications, which contained no clause concerning the speed to be attained, although the repor has been widely circulated that, before being accepted, she would have to make a certain number of knots in rough and still water. There was no provision relating to speed. She has shown that a speed of sixteen knots is possible, and this is considered excellent.

The guns of the boat will next be tested, and the crew drilled in their handling. In an early issue we purpose to present engravings of the various guns, showing how they are mounted and manipulated and how the ammunition is handled.

Payment by the Hour.

In the "Declaration of Principles" adopted and promulgated by the national association of master builders, it is stated that "this association earnestly recommends to all its affiliated associations to secure as soon as possible the adoption of a system of payment by the hour for all labor performed, other than piece work or salary work, and to obtain the co-operation of associations of workmen in this just and equitable arrangement." In some cities where the system of paying for labor by the hour is not in vogue, there is some query as to just what the system includes.

In Chicago, ever since the great fire of 1871, nearly all contractors have been in the habit of paying for their labor by the hour instead of by the day. By the old custom of paying by the day, still in almost general use, the day was made the unit of time and of payment. A quarter of a day was made the smallest division of this unit. If a man did not work a quarter of a day, he received no pay. If he worked over a quarter of a day, he received pay for half a day, etc. This is unjust to the laboring man who works but an hour and is suddenly called away. It is equally unjust to the contractor who pays for half a day when he only receives but a little over a quarter.

In the payment by the hour system the hour is made the unit of measure, and all time is kept by the hour. If a man works less than half an hour it is not counted. If he works over half an hour, he is credited with an hour.

The number of hours in a day's work does not affect the system at all, and all contractors reserve the right to work as many hours as is necessary and agreed. Overtime is credited as time and a half, and Sundays as double time. A man leaving work without permission is discharged, but when he leaves with permission he is paid for exactly the amount of work he has accomplished. This is all there is to the payment by the hour system. Those who have tried it like it infinitely better than the old method.—*Sanitary News.*

Phosphates from Rock.

A process lately patented in Germany by Haenisch and Schroeder, for the manufacture of precipitated phosphates from any kind of the ordinary crude rock, is as follows:

The rough material being first reduced to a very fine powder, is treated with just sufficient sulphuric acid to transform the carbonate and any free lime into sulphate. The mass is then subjected to the action of aqueous sulphurous acid, which dissolves only the tricalcium phosphate and leaves the other constituents as a sediment.

The clear liquid is decanted and subjected to a gentle heat. Sulphurous acid is given off and reabsorbed in water, by means of a simple mechanical device, the phosphate itself being precipitated, washed, dried, and passed through a disintegrator.

Th preliminary treatment prevents the combination of the carbonate or free lime which would otherwise take place with the sulphurous acid, and averts the formation of a mixture of calcium sulphite in the final product.

Asbestos in Russia.

From Orenburg to Ekaterinburg, the country is declared to be thickly dotted with asbestos deposits, while near the Verkni Tagil iron works is a hill, called the "Sholkovaya Gora," or Hill of Silk, which is stated to be entirely composed of asbestos. The mineral is said to be of the best white quality, and adapted for all important purposes to which asbestos is applied. In the Goroblagsdat district of Perm similar deposits crop above the surface, and any quantity can be obtained for nothing, the mineral possessing no value in the Ural region.

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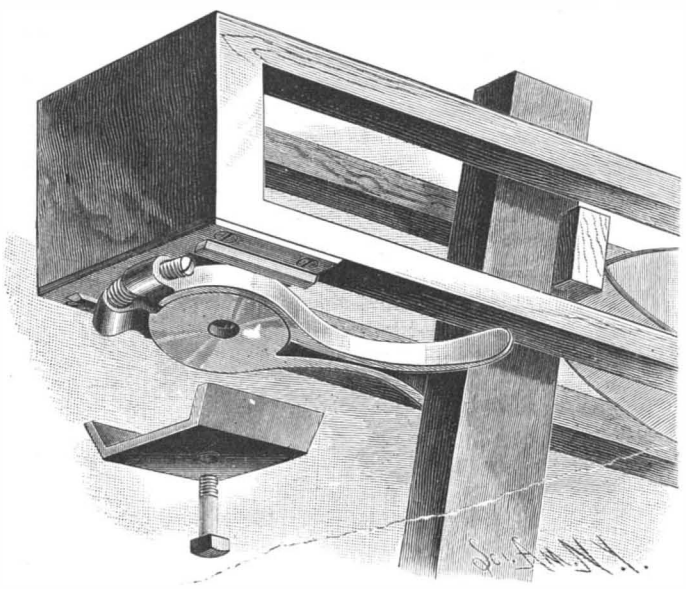
IMPROVED SHUTTLE CUSHIONER FOR POWER LOOMS.

Various appliances have heretofore been proposed for avoiding the waste of filling, and sometimes imperfect work, on account of the picker stick resting in a dead or solid manner against the "lathe block" as the shuttle comes upon it. The illustration herewith shows an improved device of this character, differing essentially from anything heretofore contrived, but yet so simple that its operation will be at once understood. The cushioner, which is made of metal, is secured to the under side of the shuttle box, one cushioner for each shuttle box. It is composed in part of a finger carrier or stand—a box or strap forming a cover for which is shown to the left at the bottom of the illustration—two working fingers, and a spring. The fingers are held in the position wished for by the



PAIGE'S SHUTTLE CUSHIONER AND PICKER STICK.

spring, which is adjusted by a screw and follower to the tension desired. When the picker stick comes back, after throwing the shuttle, it rests against or within the mouth or flaring front end portions of the fingers, and the shuttle upon its return forces the picker stick gently back between the fingers against the pressure of the spring, the fingers holding the picker stick until the next beat of the loom. This prevents any recoil of the shuttle, and obviates slack filling, which might make kinks in the cloth.

This invention has been patented by Mr. James H. Paige, of Leadville, Col.

BEET SUGAR MANUFACTURING PROCESSES.

Lime and carbonic acid are manufactured at the same time.

The shape of lime kilns varies with the engineer who designs them.

The most common form is a truncated cone, and to calcinize 10 tons lime per 24 hours, the kiln should be about 21 feet in height, 9 feet at the bottom, and 3 feet diameter at top. The interior is lined with refractory bricks, and at regular intervals, externally, are bands of iron. They should be tightened when the kiln is working and loosened when the operation has ceased. To prevent injurious action of the weather, it may frequently be desirable to surround the kiln with a light structure.

The limestone is introduced in pieces of moderate size, mixed with one-fifth its weight of coke. Filling and emptying occur every two hours, and the furnace doors should be easily worked, as upon them depends the amount of draught.

As about three days are required for the comple calcination of limestone, it is evident that the capacity of the kiln should be about three times greater than the lime required for use per 24 hours.

A kiln of the dimensions above described will furnish about 12,000 kgs. of carbonic acid, but only one-half of this actually combines with the lime during defecation.

The *Sugar Beet*, to which we are indebted for these particulars and the engraving, says that it is estimated that 100 kgs. coke are sufficient to calcinize 1,100 of limestone. Frequently lime kilns are fired with wood charcoal, under which circumstances very large quantities are needed. Coke and charcoal are the only kinds of fuel advisable to use when producing lime and carbonic acid for sugar factories.

If, instead of these, ordinary coal were employed, there would result sulphureous gases, forming objectionable sulphate of lime during the carbonatation. Humidity of the limestone is also a cause of considerable loss through the surplus fuel necessary for its evaporation before the ordinary calcination can commence.

The engraving shows a most interesting type of lime-kiln, differing from any other in that its fire grate can receive a rotary movement; and its internal cylindrical shape causes a considerable saving in the first cost of the plant. There is also a very large production of carbonic acid and lime, together with a methodical system of working and economy in fuel and annual repairs.

It is desirable that lime kilns be not too high, as the resulting carbonic acid would frequently be changed into carbonic mono-oxide in passing through the burning coals. The gas engine should, as far as possible, be worked to satisfy these conditions, viz., keep the zone of combustion always at about the same height. Regularity of working is essential for the success of the lime kiln.

Many German manufacturers use quicklime for defecation, but this is a mistake, as it introduces impurities which may offer considerable trouble in the various processes. In France, on the other hand, slaked lime, or milk of lime, seems to have preference. Doubtless this has the advantage of presenting no lumps, stones, etc., and of allowing more thorough mixture of the lime with the juice on leaving any apparatus. A few remarks respecting the preparation of milk of lime will not be out of place here. For this purpose two vats are used, in one of which the quicklime is slaked with excess of water.

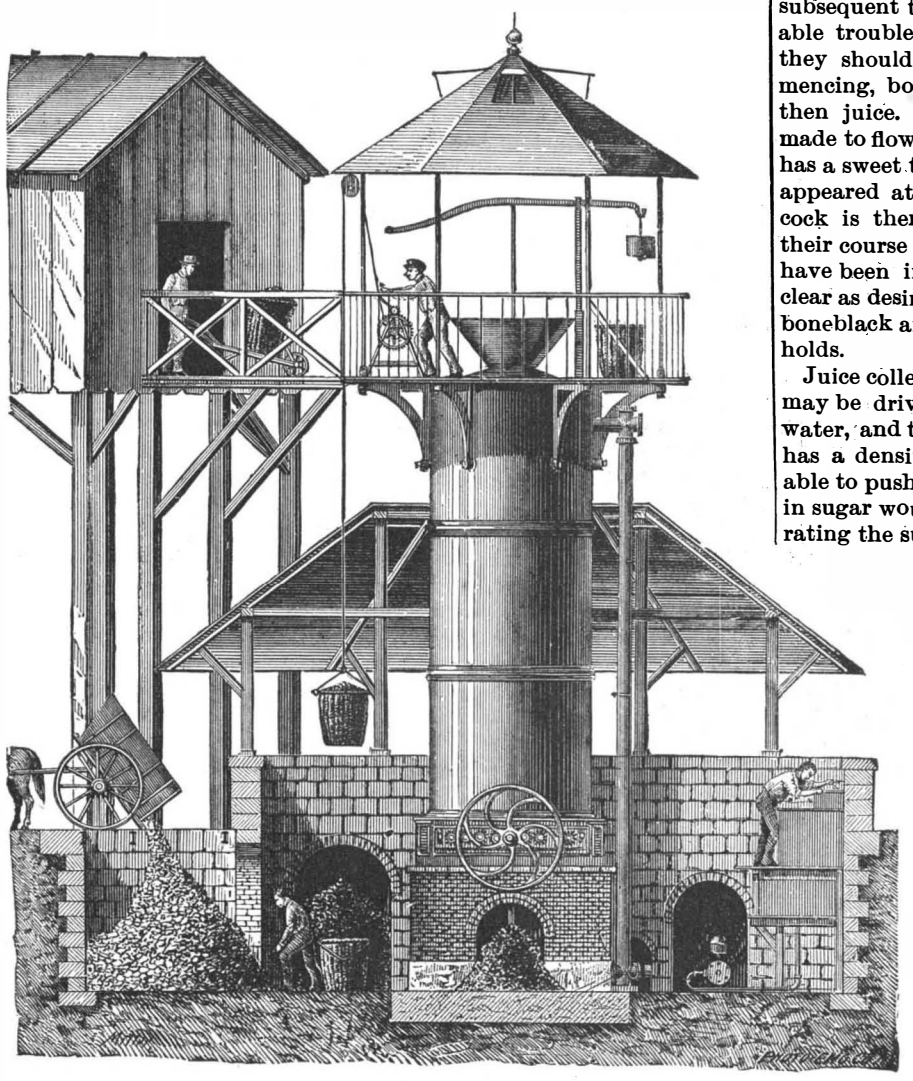
The milk of lime thus produced is strained before being run into the second vat—thus depriving the liquid of small stones, etc.; and homogeneity is preserved by suitable agitators. The limed water either flows into a *monte jus* or pumps, and from thence into defecating tanks or into a special storage tank at convenient distance.

On leaving the lime kiln the carbonic acid is hot, and contains a certain amount of impurities. The temperature should be lowered and impurities separated. For this purpose the gas is run through an apparatus known as the washer.

It is composed of a vertical cylinder with several horizontal layers of water separated by perforated metallic sheets. The gas enters the apparatus from below, and meets a current of water moving in opposite direction; sometimes also a filtering substance, such as sand or boneblack, is placed in the diaphragms.

The gas engine in connection with the lime kiln is a double-acting suction and force pump, capacity calculated to suit the requirement in length of stroke and diameter of piston, which are usually equal.

The pump most generally used is without *clapet* (hinged valve), and the movement is given by a steam engine mounted on the same frame.

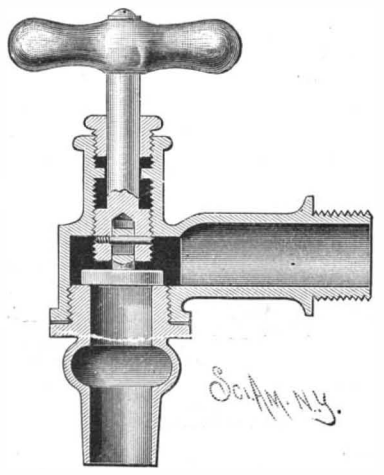


LIME KILN FOR CARBONIC ACID PRODUCTION.

It may be interesting to call attention to the fact that frequently the pumps draw from the kiln more carbonic acid gas than is necessary for defecating. Under these circumstances a valve on the connecting pipe opens, and permits escape into a pipe conducting outside the factory.

The juice, after being defecated, still retains certain coloring substances most difficult to eradicate, but the decolorizing property of boneblack has aided greatly in this process.

The boneblack filters are large cylinders, of diameter much less than their height. There are two modes of working them: (1) under pressure, (2) without pressure. In the first case the filters are closed, and filled from tanks placed on the upper floor. In the second method



SMITH'S METAL VALVE OR TAP.

[FOR DESCRIPTION SEE PAGE 325.]

the juice falls directly into the filter through a suitably arranged valve, by which the flow of juice may be regulated.

The closed filters have a greater popularity than those in use without pressure, and are the most used in large factories. They are cylinders of about 2 feet diameter and 12 feet in height, and their general arrangement is much the same as that of the old type. The upper part of the apparatus is closed within a dome, which can be opened or closed by means of a screw. From the dome runs a distributing pipe, connecting with the hot water, sirups, etc. As the filter before filling contains a certain amount of air, a small pipe and valve should be provided to permit the air to escape. These closed filters may be made to connect one with the other, and in this manner juices can be filtered several times—representing the decolorizing effect of a filter of very great height.

While bone filters may be used for juices, sirups, molasses, etc., it is advisable to have a special filter for molasses, as the impurities remaining in the boneblack subsequent to filtration might be the cause of considerable trouble. Whatever be the kind of filters used, they should be kept as clean as possible. On commencing, boiling water should be run through, and then juice. The water contained in filters may be made to flow out from below, and as soon as this water has a sweet taste, it is an indication that the juice has appeared at the lower part of the filter. The waste cock is then closed, and the filtered juices continue their course as previously described. When the filters have been in use for some time, the juices are not as clear as desirable, and it is needful to empty them of boneblack and cleanse the last from the impurities it holds.

Juice collected in the pores of the filtering substance may be driven out. This can be done by pressure of water, and the operation is ended when the exit liquid has a density corresponding to 1° B. It is not advisable to push the washing beyond this limit, for the gain in sugar would not compensate for the cost of evaporating the surplus water. Great care should be given to the thorough cleanliness of the filters. Hence the importance of washing them with steam, after the exhausted boneblack has been removed. Bone filters should be covered with some non-conducting material, to prevent sudden cooling.

BEFORE the Berlin Physical Society, Prof. Vogel recently produced three fluids in three flat phials—one yellow and two blue fluids—which he made use of in demonstrations regarding color mixture, in order to dispel the belief which prevailed very largely among the public that yellow and blue when mixed yielded only green. Phial 1 contained "acid yellow" (*Sauregelb*); phial 2, solution of ammoniacal copper; phial 3, aniline blue. 1 and 2 superimposed on each other gave green; 1 and 3, a fiery red.

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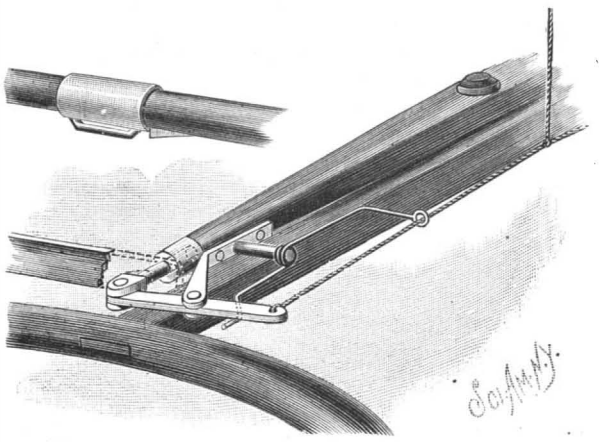
DEVICE FOR DETACHING HORSES FROM VEHICLES.

The engraving herewith shows a simple, practical device whereby a horse may be instantly detached from a vehicle by a person riding therein, to avoid danger in case the horse becomes unmanageable. The whiffletree has a socket in each end to receive bolts, which pass through the traces, and serve as holders therefor. The bolts are each hinged to a lever pivoted to a bent arm secured to the whiffletree, the lever being held a short distance beyond the end of the whiffletree. The rear ends of the two levers are connected together by a cord, and to the center of this cord is attached another cord, which leads into the vehicle or to within convenient reach of the driver, so that by drawing upon this cord the rear ends of the levers will be drawn toward each other and their opposite ends carried outward, thus withdrawing from their sockets the bolts which hold the traces. To prevent the bolts from jarring out of the sockets, a pivoted rod is bent to form a locking device, but it readily releases the bolt when the cord is drawn upon, or is depressed by hand for that purpose when unhitching the horse in the ordinary way. Upon the thills are placed loosely holdback sleeves, one of which is shown in the illustration, which come against holdback stops on the thills.



WHITE'S IMPROVED HORSE DETACHER.

When the traces are released by pulling upon the cord, these sleeves readily slide off from the thills, and thus wholly detach the horse from the vehicle.

This invention has been patented by Mr. Thomas White, of Peekskill, N. Y.

A NIGHT SIGHT FOR ORDNANCE.

In many respects, says *Engineering*, the development of modern weapons of warfare has given increased value to the employment of operations during night time. This is notably the case with all varieties of torpedo operations, which may, indeed, almost be said to be limited to night time for successful results. The employment of artillery enters largely into the defense against this class of attack, in addition to which the use of artillery fire at night, as in bombardments and siege operations, proves most efficacious if correctly applied.

Although great accuracy has been attained in the fire of modern rifled ordnance by day, the question of getting a similar degree of accuracy of fire by night, though not overlooked by artillerists, has not yet been satisfactorily worked out. It has been the difficulty of obtaining an accurate mode of directing a gun on an object which has hitherto stood in the way of the effective employment of artillery fire at night. The instances are numerous where an accurate night fire is of great advantage, as, for example, the defense of a ship against torpedo attack by the fire of her guns, great and small; the artillery defense of a harbor entrance, or other channel, against the endeavor of a hostile squadron to pass or force it; the fire directed against a fleet attempting a night bombardment; the protection of mine fields, booms, and obstacles; and siege operations. These are all instances in which the power of accurately laying guns at night is of importance. In addition to this, the effective use of position finders and of observation mines at night largely depends on being able to obtain an accurate alignment on the object to be attacked.

In view of these requirements, there has been no lack of endeavor to provide means for directing the fire of guns at night, in other words, of furnishing an efficient night sight for ordnance. The problem, however, is somewhat awkward, for though many sights have been devised with which an alignment of some description can be obtained, difficulties have arisen which have prevented their successful application.

Briefly stated, the problem is how to provide a sight which shall be susceptible of great accuracy of definition and adjustment, and yet be such as in no way to blind the observer's vision or obscure his perception of the object aimed at. Every one who has had to do with the sea is aware how blinding on a dark night is the effect of any considerable light on the eye, and how completely it prevents the observation of a dim object.

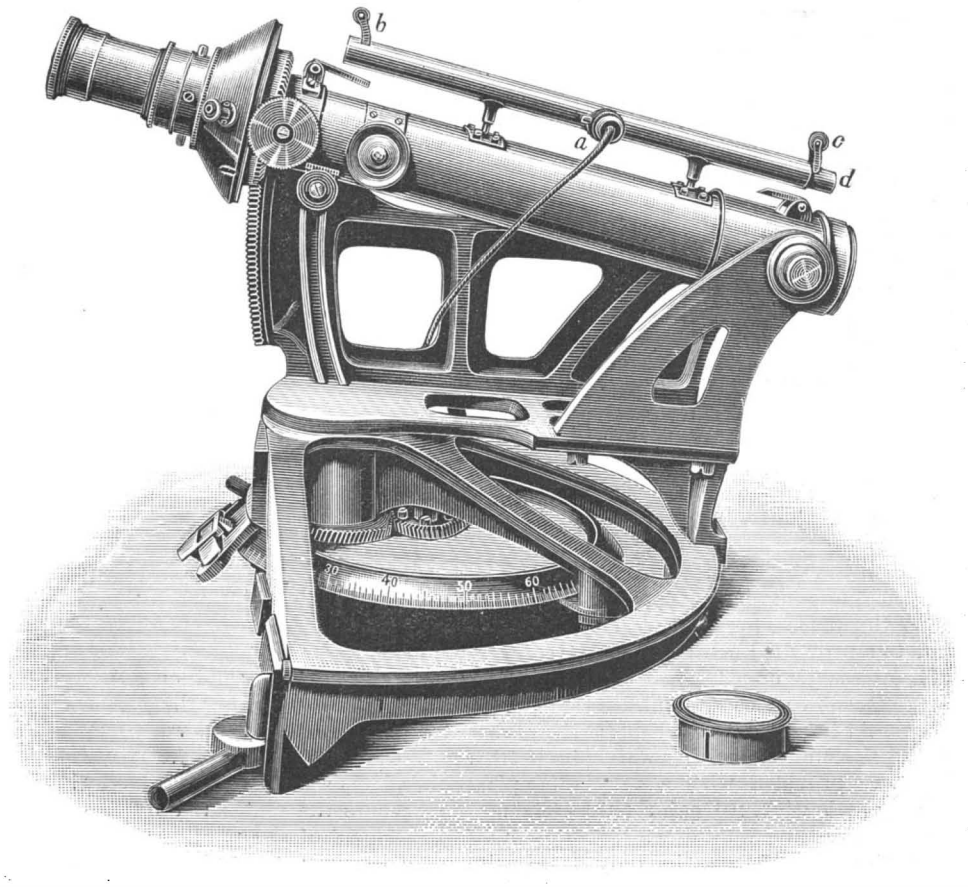
Many sights, as has been said, have been proposed, some of which give admirably defined points of more or less brilliancy. Phosphorus, enamel, luminous paint, mother-of-pearl, reflected or direct rays of light, have all been pressed into service, but the difficulty has always been that just in proportion as the sights are rendered visible, the amount of light thrown on or proceeding from them dazzles the eye of the observer, and renders it impossible to keep in view the object on which the alignment is desired. The eye, in fact, sees the sights, but at once loses the object.

In the night sight recently brought out by Sir W. Armstrong & Co., at Elswick, of which we give an illustration on this page, an alignment is obtained which is easily discernible by the eye under all degrees of dusk or darkness, is capable of even more accurate adjustment than the usual day sight, and is so arranged that even on the darkest night in which fire is possible, the observer's eye is in no way fatigued or blinded by the illuminated points.

The sight is made in several forms, according to the purpose for which it is applied. When used with the director for discharging guns from a central position or for the sighting positions in turrets or barbettes, light is transmitted by reflection from an electric lamp through two small spherical lenses, where it concentrates in two minute and easily adjusted points of light. For the torpedo director used for discharging torpedoes, and for direct use with larger guns, two lamps are employed, while for smaller guns, such as Hotchkiss and other three-pounders and six-pounders, two separate sights, each with its lamp, take the place of the ordinary day sight.

As most war ships are now fitted with the electric light, the application of these sights is arranged in connection with the light circuit. A short length of wire with a terminal in a convenient position close to the gun or director enables the sights to be illuminated as desired.

The purposes for which these sights are applicable are for directing instruments for discharging guns and torpedoes either on board ship or in forts and coast batteries; for ordnance generally afloat and ashore; and for position finders and observation mines. The engraving shows night sight applied to a naval director for discharging guns.

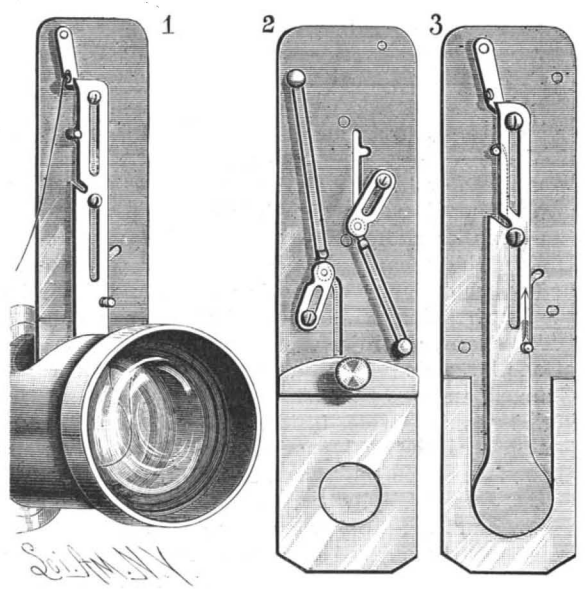


NIGHT SIGHT FOR ORDNANCE.

THE great value of nitrate of soda, a material our cultivators are only beginning to learn the value of, is to hasten the growth of plants early in the season, and for this purpose it has no equal.

IMPROVED CAMERA SHUTTER.

The camera herewith illustrated is extremely simple in construction, and quick and reliable in operation. The shutter is designed to be inserted in the diaphragm opening in the lens tube. It consists of two principal parts. The main plate, Fig. 2, is composed of two sections, the upper one of which carries the slide, Fig. 3, which normally closes the exposing aperture in the lower section. It is designed to have several of the lower sections with apertures of different sizes, so that the proper exposure may be effected in any light, by selecting the section of proper aperture, and attaching it to the other by some simple means. Attached to



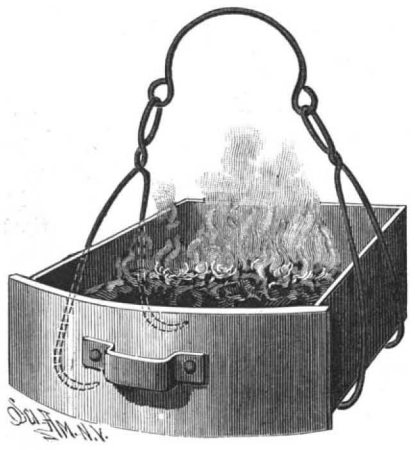
BETTS' IMPROVED CAMERA SHUTTER.

the main plate and to pins sliding in slots in the plate, and adapted to engage notches in the slide, are two elastic bands so arranged that when the holding catch at the top of the main plate, Figs. 1 and 3, is tripped, one band will raise the shutter to the top, when the second band will instantly act to pull it down. In Figs. 1 and 3 the parts are in position to be operated, while Fig. 2 shows the bands after the slide has been moved to make the exposure. The extreme simplicity of this device, and the certainty of making an instantaneous exposure, are evident.

This invention has been patented by Mr. F. K. Betts, of 2028 Madison Avenue, New York City.

CARRIER FOR ASH PANS.

By means of this simple device, a pan of ashes can be conveniently and safely carried without danger of spilling the hot cinders or burning or soiling the hands. The handle is made of stout wire, and to each end is attached a hook, made of a single piece of wire, shaped



COLEMAN'S CARRIER FOR ASH PANS.

as shown in the engraving. The extremities of each of these wires are separated from each other, and are sharpened and curved inwardly and upwardly to constitute grips. The ash pan having been drawn from under the grate by one of these hooks, is then seized with both hooks in such a way that their points pass under the bottom of the pan. The handle is then grasped, and as the pan is lifted, the shanks of the hooks are brought firmly against the sides, when the pan, thus evenly and securely held, can be safely carried.

This invention has been patented by Mr. Francis W. Coleman, of Rodney, Miss.

COMMERCIAL TRAVELERS' TAX CASE.—The Supreme Court of the United States has, in the case of Gorson vs. Maryland, declared unconstitutional the provision of the Maryland code requiring any one not the grower, maker, or manufacturer selling goods within the State to pay a license tax proportioned to the amount of his stock in trade, whether situated in the State or out of it. The court held that this provision was a regulation of interstate commerce, and therefore invalid as to persons living out of the State and selling by sample within it.

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THE HUDSON RIVER TUNNEL.

In some respects a most remarkable piece of submarine engineering was that begun some twelve years ago, when the first work connected with the tunnel to unite Jersey City and New York by a passage under the bed of the Hudson River was done. Important to the engineer because of its vast magnitude, the difficulty and danger attending its prosecution, and particularly because of the new methods of working introduced; important to commerce, as it would afford a quick and sure means of crossing the river, and would reduce the time between New York and the South and West on each of the great railroads terminating at Jersey City. The work has not been carried forward continuously. During 1882 the headings were advancing rapidly, and the underground affairs looked very bright, when a financial stumbling block was met, and all work ceased in the fall of that year. Since then the tunnel has been flooded. A short time ago the water was pumped from the New Jersey end, the compressors started, and now the heading of the north tunnel is moving toward the opposite shore. We understand from Mr. D. C. Haskin, the manager of the company, that there will be no further difficulty concerning funds, and that all of the four headings will be opened as soon as possible.

The plans, as projected, contemplated the erection of one large double track tunnel, but this was soon changed, and two parallel single track tunnels, 18 feet high by 16 feet wide, inside, were substituted. That section of the tunnel passing beneath the river ends at the foot of Morton Street, New York, and Fifteenth Street, Jersey City, where the approaches begin that will extend the tunnel at an easy grade to the surface. Work was commenced at the western end by sinking a brick shaft 30 feet inside diameter down to the line of the tunnel, 60 feet. At 29 feet from the top an opening was cut through the river side of this shaft, and an air lock 6 feet in diameter and 15 feet long was forced in by hydraulic jacks until its inner end projected a short distance beyond the face of the wall. The lock was then entered, its outer door closed, and an air pressure of 12 pounds admitted, when the inner temporary wooden door was removed and the iron one replaced. The earth was then gradually dug away, and plates were inserted to form a tube 8 feet long extending horizontally from the end of the air lock. This work was intently watched, as it was the first practical test of the system adopted, and it established the fact that the material passed through was sufficiently tenacious to separate the air upon one side from the water upon the other, and that it would serve as a self-sustaining wall as long as the air and water pressures were kept nearly equal upon each side. Eleven rings of plates, each 2 feet wide and each 18 inches larger than the one preceding, were built from the tube, thus forming a cone, the lower side of which was stepped. From the last ring, which was 20 feet in diameter, the two tunnels were started, the material being excavated a little at a time to admit iron plates, constituting a tube, within which the masonry was placed. No serious difficulty was met except when passing the piles of the dock, some of which were in the line of the tunnel, and had to be cut off. The silt was more ready to flow, and had to be exposed very carefully. It was found that the crown plates, owing to the pressure of the silt upon them, would settle somewhat before the masonry could be laid. Digging out more than was necessary, so as to allow for settling, did not obviate this, as the rate of settlement, owing to slight differences in the character of the material, which could not be gauged, was unequal. This led to the introduction of the "pilot," which was a tube six feet in diameter, built of interchangeable flanged plates and having a length sufficient to permit its forward end to enter some distance into the heading and its rear end to be abreast the completed masonry. Each end being thus supported, the intermediate points served as a center from which to brace the plates. After this there was no trouble in keeping all parts of the tunnel in line. When the headings of both tunnels had been advanced several hundred feet, work in them was stopped and the removal of the cone-shaped entrance from the lock was begun. The intention was to build a masonry connection between the shaft and ends of the tunnel. When this section had been nearly all excavated, the roof near the inner end of the lock caved in during a change of shifts, and the door was so wedged and held by the plates as to prevent twenty men from entering the lock. After vain endeavors to remove the obstructions, the outer door of the lock was opened, and those who had passed the barred door escaped. The air being thus removed, the work was soon flooded. To recover the bodies and again start the work, a caisson 41½ feet by 24 feet 10 inches was sunk between the shafts and tunnels. When the caisson rested in line with the bottom of the shaft, holes were cut through its eastern side and connection made with the tunnels; the opposite side was then pierced, and the shaft entered. The entire interior of the caisson was then lined with brick, forming a large working chamber, from which, before the shaft opening was made, all the supplies were handled. In each tunnel at 430 feet from the shaft, bulkheads were built, and in each were placed two independent air locks, similar to the one in the shaft; the tunnels between the locks and shaft were then relieved of air under pressure. The south tunnel has been finished for 600 feet. A second bulkhead, having one lock, was built in the north tunnel 800 feet from the shaft, and a third at 1,200, when the first one was removed. The north heading has been carried 1,600 feet.

At the New York end, the conditions being different, the plans were slightly modified. The caisson there sunk was 48 feet long, 29½ feet wide, and 25 feet high. The interior was rectangular instead of being circular, as in the case of the other. It was provided with the usual locks for men and material. The caisson was sunk until its shoe was 60 feet below high water and 3 feet above the line of the exterior of the invert of the tunnels. The caisson was then completely embedded in sand and gravel which had little holding power upon the air as compared with silt. The sand at the bottom of the caisson was dug out, and in each small excavation as made, a flanged plate was inserted, bolted to those adjoining and held by braces. Brickwork was then laid upon this iron shell. This plan provided a working chamber similar in many respects to the one at the other shore. The caisson wall was then cut through and the tunnels started. To keep the exposed portion of an excavation from flaking, planks were instantly placed against it to hold it until the plates could be bolted and braced. The material at the heading was held by a movable bulkhead of plates. In building this portion, it was absolutely necessary to covere very part of the interior with plates, which were supported by braces, the air pressure being depended upon to counterbalance the water pressure. When a section, ten or twelve feet, had been plated, it was cleaned, and the masonry put in as upon the other side. When work was stopped in 1882, the north tunnel had been completed nearly 200 feet, and its heading was about half in sand and half in silt. The south tunnel was 30 feet from the caisson. The accompanying engraving shows the line of the tunnel, the distance completed, and that remaining to be done.

A representative of this paper visited the tunnel recently, and after donning the prescribed regimentals —rubber boots, coat, and an old hat—passed through the locks to the heading of the north tunnel under the guidance of Mr. C. A. Haskin, the superintendent. Near the mouth of the shaft are the boilers, air compressors, and dynamo supplying the arc lamps that light the tunnel. Running in the shaft is an elevator, carrying the men and material up and down. A track leads from the elevator to the place where excavated material is dumped and to a near dock where all the supplies are received. The cement is mixed dry at the top, in the proportion one cement to two sand, and is taken to the heading in bags. At the bottom of the shaft is a pump which drains the shaft and furnishes water to the heading. Being here provided with a very thick candle having a very little wick, we enter the left of two large gloomy openings and walk down the north tunnel 800 feet to the first air lock, the only bright, untarnished part of which is its glass bull's eye. Its four years' bath has completely covered it with a thick rust. The tunnel appeared to be in the same condition as when we last saw it; no cracks could be seen, and even the cement washing covering the masonry had flaked off only in small pieces.

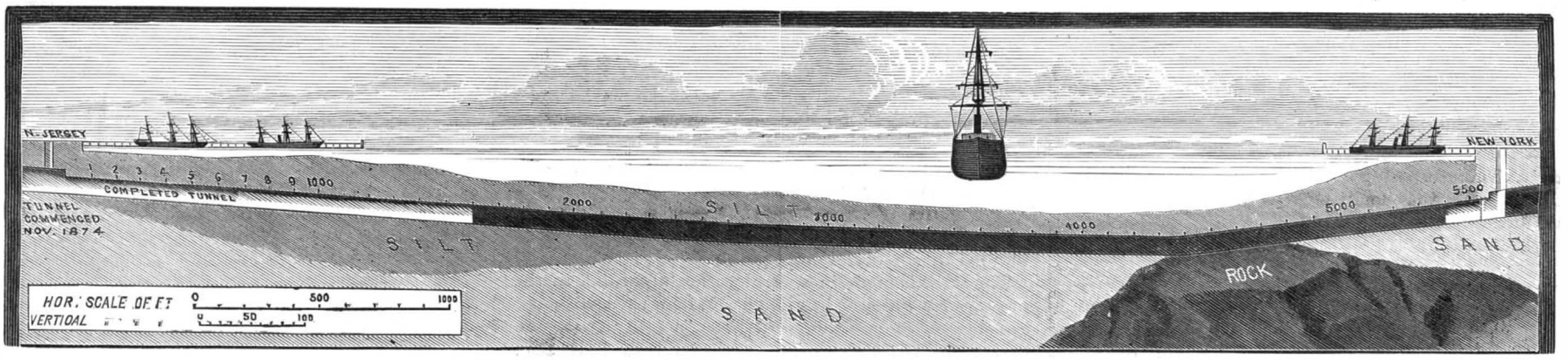
Entering the lock and assuming as comfortable positions as its circular form would permit, and being careful to keep out of the line of the air entering through the forward valve, we were soon under a pressure of 22 pounds to the square inch. Passing into the next or middle section and walking 400 feet, the second lock was met. Through this, and we were under the full pressure of 27 pounds, and after stumbling and splashing—the illuminating power of a single flickering candle is not great, and the sections are only fully lighted at each end—400 feet further, we were at the heading.

When the work was stopped, a rough timber bulkhead was built across the heading and through the cracks; in this the silt had entered, completely filled the heading and gone up the tunnel, gradually decreasing in thickness, over one hundred feet. After this had been removed, it was found that the entire pilot had moved about 18 inches toward the north or up stream, and as the plates projecting beyond the end of the tunnel masonry had been braced from the pilot, they were forced outward to a like extent. The plates at the roof and south side were bent inward, but only a few inches. Why the pilot should shift as it did has not been explained. One would naturally suppose that no movement would occur other than in a vertical direction.

One section of 10 feet has been finished, another section has been lined with plates, and the heading has been extended correspondingly. In no particular have the plans been changed. The face of the cutting is divided into steps, in order that the men can easily reach and remove the silt from all points. When an excavation has been made, a plate is put in and bolted to those adjoining. This work is of course begun at the bottom and carried up, so that the outer edge of the plates is parallel with the heading. The plates are supported from the pilot by braces, which are removed as the brickwork advances. The labor is so divided that the heading, plates, and masonry move forward at the same rate. The exposed silt is not protected, except by a braced plank here and there, to prevent large masses from falling, and yet it answers perfectly as a dividing wall, preventing the passage of either air or water, and having strength enough to resist any slight excess of pressure there may be upon either side of it. The silt cuts easily, and may be taken out in regular blocks, and yet when mixed with a little water it is more difficult to confine than quicksand. The pressure of the air is regulated by the condition of the silt itself; when the pressure is too great, the water is driven back and the silt drops off in little flakes, and when it is not enough, the water weeps through and runs down in little streams.

The required pressure does not depend directly upon the height of the water or the depth of the tunnel below the surface of the river, but seems to be more nearly controlled by the density or compactness of the silt. A small leak can only be detected by passing a candle flame over the face of the silt, when the flame will be drawn in by the outrushing air. A larger leak makes a noise precisely resembling the blowing off of steam. A little silt applied to a leak will effectually stop it, and as the opening rapidly grows, the remedy must be quickly applied. Mr. Anderson once tried a novel way of stopping a leak that was rapidly growing dangerous, by forcing his shoulders into the opening. He was instantly caught by the air and held until the silt had settled down behind him, when there was ample time to force silt into the weak spot. It is safe to predict that this method will not be generally adopted. During the work through the sand on the New York side, the best material for covering the joints between the plates to make them air-tight was silt which was brought from the other side, and so freely used that in some places the plates were entirely covered with it.

The masonry where the plates had been forced outward by the movement of the pilot was increased to 4 feet in thickness, in order to prevent there being any break in the plates; and to reduce the thickness to the



PROGRESS OF THE RAILWAY TUNNELS UNDER THE HUDSON RIVER BETWEEN NEW YORK AND NEW JERSEY.

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usual 30 inches, each ring of plates is separated from the two on each side by blocks of wood, so that the opening between the plates is wedge shape, the rings touching on the south side, and being a few inches apart on the north side.

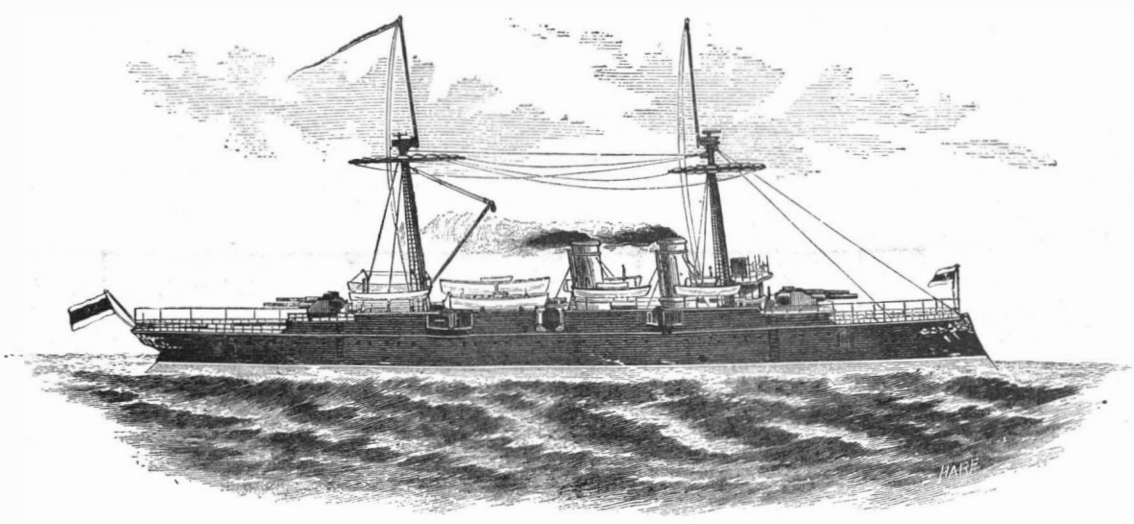
The way in which the supplies are brought in and the excavated material taken out will be understood if we follow a load of silt from the heading to the surface. It is loaded upon a small car, which is pushed along a track up to the lock, into which it is rolled over a short section of movable track placed across the sill of the door. Having passed this lock, it is drawn to the second one—first from the shaft—by a mule, which seems to be contented to work continuously under compressed air. This animal has been in the tunnel for three or four weeks, and his physical condition appears to have been most decidedly improved. Passing this lock, the car is drawn by a second mule to the bottom of the shaft, where a small turntable guides it to the elevator, up which it is lifted and then hauled to the dumping ground. Supplies for the heading go over the same route, and are handled in the same way, except that, the grade being down, the cars run by gravity. It is expected to soon replace the arc lights now used at long distances apart by an incandescent system, as the light can be more evenly and generally distributed.

The journey out of the tunnel is quickly made, and it is certainly with a marked sense of relief that the investigator of dark places finds himself in the wash room at the top of the shaft, removing all traces of his travels.

NEW ARMORED CRUISER FOR THE SPANISH NAVY.

On February 24 there was launched from the shipyard of Messrs. J. & G. Thomson, Clydebank, a new Spanish cruiser, named the Reina Regente, of which our illustration is a general external view as she is intended to float when finished.

This vessel was contracted for after the leading shipbuilders in Britain and other countries had submitted competitive designs to the Spanish government, the designs submitted and since carried out by Messrs. Thomson being adopted. Among the conditions laid down by the Spanish authorities to be fulfilled in this vessel were that she was to be of the protective deck type, the deck having a thickness of 3¼ in.; to have four 20 centimeter 12 ton guns, six 12 centimeter guns, and a numerous small armament; to be able to maintain a speed of 19 knots, and to have a radius of action of 5,500 knots. These stipulations have been much more than met in the vessel as constructed, her builders having arranged for a protective deck of 4¾ in., four 24 centimeter 21 ton guns, six 12 centimeter guns, a speed of 20½ knots, and a radius of action of as much as 12,000 knots.



THE REINA REGENTE, NEW ARMORED CRUISER FOR THE SPANISH NAVY.

The Reina Regente is 330 ft. long, and in fully equipped condition she will displace 5,600 tons, although her usual sea-going displacement will not exceed 5,000 tons. She is of steel throughout, and depends for her protection in an engagement partly upon the armored protective deck and partly upon the unusually minute subdivision of the hull between this deck and the one above it; or, in other words, of that part of the ship between wind and water. This part is divided into no fewer than 83 separate watertight compartments, most of which will be used as coal bunkers. The space below the armored deck is divided into 60 watertight compartments, and for the whole length of the vessel a cellular bottom is fitted. The total number of watertight compartments in the ship is 156.

The vessel will be propelled by twin screws, the engines, contained in separate watertight compartments, being of the horizontal type, triple expansion. The boilers, four in number, are also in separate watertight compartments. Well above the water line there are two auxiliary boilers, supplied by Messrs. Merryweather, for raising steam rapidly in cases of emergency. These boilers are connected to all the auxiliary engines on board, which altogether number no fewer than 43. In addition to the two sets of main engines, there are two starting engines, four centrifugal pumps, bilge and fire pumps, feed pumps, ten fan draught engines, steering engine, capstan engine, two electric light engines, two boat hoisting engines, also ash hoisting engines. The four centrifugal pumps are connected to a main pipe which runs right fore and aft, receiving branches from every compartment. The branches are so arranged that the compartments are always in connection with the pumps, and if they become flooded are immediately pumped out; but if water seeks to enter the compartment from the pipe, it is at once prevented by an automatic valve. Should it be desirable, however, to flood any compartment, the action of this valve can be suspended. The automatic nature of this pumping arrangement should be of the greatest value in an engagement, when men have little time and little power in which to think and act.

The highly important quality of turning power has received special attention in this new cruiser. The patent sternway maneuvering rudder of Messrs. Biles & Thomson, introduced with very marked success in the recently built Spanish torpedo cruiser El Destructor and the Russian torpedo boat Wiborg, is again a noteworthy feature in the new vessel. This contrivance, it may be mentioned, is a combination of a partially balanced rudder with a rudder formed as a continuation of the after lines of a ship. The partial balance tends to reduce the strains on the steering gear, and thereby enables the rudder area to be increased without unduly straining the gear.

The armament of the Reina Regente is, for her size, very formidable. It comprises four 24 centimeter and six 12 centimeter Hontorio guns, six 6 pound Nordenfelt guns, fourteen small guns, and five torpedo tubes. On the main deck, right forward, there are two torpedo tubes, there is one aft, and one in each broadside amidship. There are four gun towers on the level of the main deck, but projecting beyond the side of the ship. Each of the two forward ones fires five degrees across the bow, and to within 30 degrees of right aft. The after guns have a similar range round the stern. The remainder of the armament is placed on the upper deck.

At the fore end there is a platform, about 4 ft. above the deck, upon which two of the 21 ton Hontorio guns are placed. These fire right ahead, and to within 40 degrees of right aft. A similar platform right aft receives the other two 21 ton guns. Between these two platforms, and ranging along both sides, are placed the six 12 centimeter guns, two of which fire forward, two aft, and the remaining two have a range of 140 degrees.

Besides the six Nordenfelt guns, there are two 37 millimeter Hotchkiss revolving guns, and of the smaller guns there are five for boat and field service and four for working from the mast heads.

The vessel will be fitted with accommodation on the main deck for 50 officers and about 350 men. The launch took place from Messrs. Thomson's yard, in the presence of a large assembly, the naming ceremony being performed by the Duchess of Wellington.—*Marine Engineer.*

Slag as a Fertilizer.

The slag from the Thomas-Gilchrist process for making steel has long been supposed to have valuable properties as a manure. In the Bessemer converter, there is a lining of lime which, in the process of manufacturing the steel, takes up a large percentage of phosphorus, in the form of phosphoric acid. Phosphate of lime has been used as an artificial manure, in a variety of forms, with very beneficial results on most lands. It was thought that the basic cinder obtained in the Thomas-Gilchrist process might, from its large percentage of lime and phosphoric acid, have a manurial value.

Some two or three years ago, experiments in this direction were undertaken in Germany by M. Fleisher and others, and from the data which they obtained, it appeared that under certain conditions basic slag had a very marked influence upon crops grown on soils which had been top-dressed with it. It was ground into a very fine powder, and then the acids of the soil were able to dissolve the phosphoric acid which it contained; and it was then in a condition to be readily assimilated by plants. Attention is again being called to this point in consequence of a series of similar experiments which have been carried out by Dr. Munro, at Downton, for the North Eastern Steel Company, and which fully confirm the earlier experiments of the German investigators. It was thought that probably the slag would be more efficacious if it were first converted into a "superphosphate," in a similar manner to bones; but Dr. Munro and Mr. Wrightson seem to think that this is unnecessary, if care be taken to have the basic cinder in as pure a state of division as possible.

As basic slag is a waste product, and hitherto has had no industrial application, it ought to be obtainable at a much cheaper rate than the Canadian apatite, coprolites, and bone manures, which have until recently been the chief artificial fertilizers used in agriculture. Dr. Griffiths has recently, in papers read before the Chemical Society of London, advocated the use of iron sulphate as a manure, and as basic slag contains a considerable quantity of iron in the same condition of oxidation as in ferrous sulphate, it may also have some effect upon the manurial value of the Thomas-Gilchrist slag.

The Latest Large Guns.

It may be assumed, says *Iron*, that we are proud of our 110 ton gun; but the satisfaction of being at the head of all other nations in gun making is destined to be but short lived, for already we hear that the formidable Krupp, of Essen, is going to lick all creation, this little island included, in the art. His latest monster, now being manufactured, is to weigh close upon 139 tons, or 143,000 kilogrammes, against our 111,760 kilogramme arm, and to have a caliber of 40 centimeters (15·7 inches). Its length is 16 meters, or 52½ feet. The projectiles to be used with this gun are of two kinds, one a steel shell 1·12 meters (3 feet 9 inches) long, and weighing 740 kilogrammes (1,630 pounds), and the other 1·60 meters (5 feet 2 inches) long, and weighing 1,050 kilogrammes (2,314 pounds), equal to the weight of the barrel of a 12 centimeter gun. The service charge consists of 485 kilogrammes (1,069 pounds) of brown prismatic Dunwalde powder. With this charge, the lighter shell will have an initial velocity of 735 meters (2,411 feet), the heavier shell one of 640 meters (2,099 feet) per second. Attention might be drawn to the fact that when rifled guns were first introduced, the highest initial velocity attained was only 300 meters (984 feet). The lighter shell will penetrate a wrought iron plate 1·142 meters (45 inches) thick, or two plates of the respective thicknesses of 0·55 meter (21·65 inches) and 0·838 meter (33 inches), placed a short distance from the muzzle of the gun. In the case of the heavier projectile, the figures are 1·207 meters (47·52 inches), 0·60 meter (23·62 inches), and 0·88 meter (34·64 inches) respectively. As far back as 1868, the artillery of the day was unable to penetrate as many millimeters of armor as now centimeters; its penetrative power has consequently increased tenfold, and Krupp is now able to pierce with his new gun an armor plate three times as thick as the bore of the gun. But he is reported to be even now endeavoring to surpass his latest achievement, for a 45 centimeter (17½ inch) gun is in contemplation, weighing 3,000 cwt. The shell to be fired from this piece of ordnance is to weigh 30 cwt., and to be 1·80 meters (nearly 6 feet) long.

A SELF-CLEANING METAL VALVE.

The illustration herewith shows a valve which turns or rotates on its seat before and after the water or steam, or both, are turned on or off, this rotating and grinding action being designed to at once repair any damage caused by the cutting and destructive force of anything in the water, as well as clean off lime scale or rust. The stem of the valve, as will be seen by the engraving, has an enlarged inner end portion, screw-threaded on its exterior, which engages a screw-thread in the barrel. The valve, which is shown closed upon its seat, is connected in a free manner with the inner end portion of the stem by a stud entering loosely within an axial recess, the parts being further united by a screw or pin fitted to pass freely through a longitudinal or oblong slot in the enlarged portion of the stem. In closing the valve, both valve and stem move longitudinally until the valve rests upon its seat, after which, by continuing to work the stem in the same direction, the valve is simply rotated, while the stem is both rotated and moved inward longitudinally. The greater the pressure on the valve, the better it will polish both itself and its seat, and no leather or rubber is used in connection with it.

This invention has been patented by Mr. Samuel W. Smith, of Pinley House, near Coventry, Warwick County, England.

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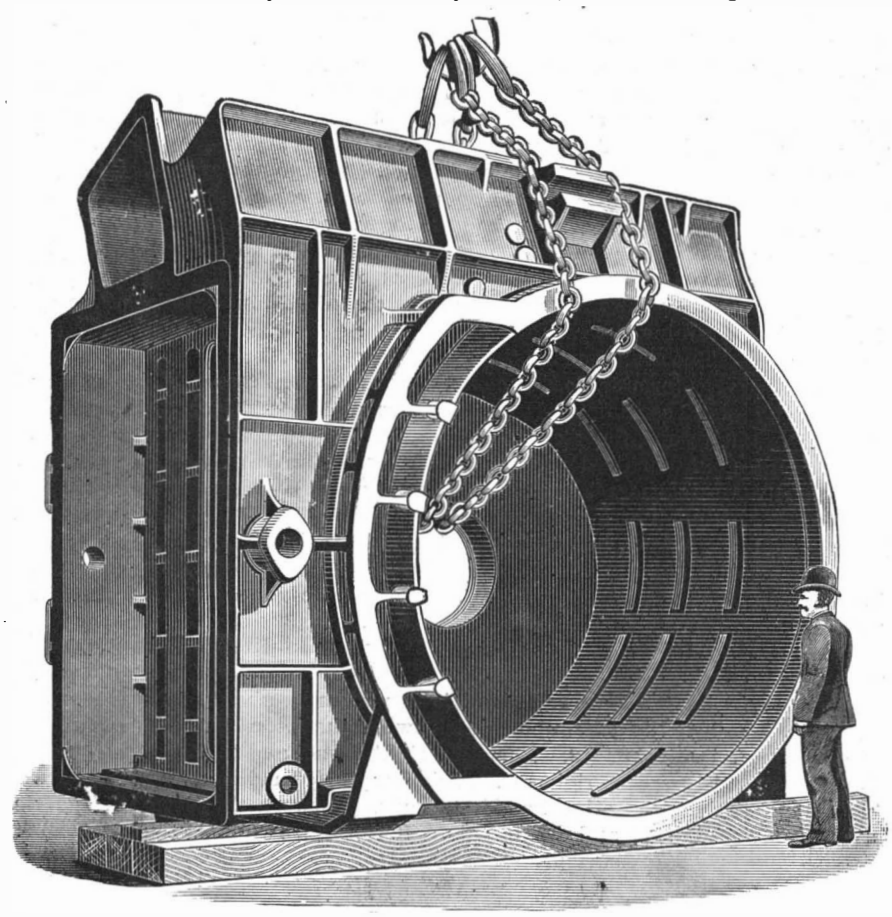
A LARGE CASTING.

The accompanying engraving from the *Engineer*, reduced from a photograph, shows a very large and fine casting, made by the Hyde Park Foundry Company, Glasgow. It is one of two large cylinders for a compound diagonal marine engine, and has been made to the order of the Fairfield Shipbuilding and Engineering Company—John Elder & Co. Each cylinder required forty tons of melted metal to cast it, and if, perhaps, we except the cylinders of the Ireland, Holyhead mail steamer, they are the heaviest ever made. Our engraving shows the cylinder without the liner, the working diameter of which inside is 112 in., with a stroke of 72 in. The finished weight of the cylinder with the liner in, lids, etc., will be about forty-two tons. The slide valve weighs fifty-nine hundredweight. The casting reflects much credit on the Hyde Park Foundry Company, which has had large experience in this kind of work, having turned out some of the heaviest castings ever made for marine engines.



A LARGE CASTING.

THE BERDAN TORPEDO BOAT.

The history of attack and defense in war has, of late years, consisted in alternating phases of advance in one and the other art. As soon as a new gun or torpedo was invented, new and more impregnable vessels or forts were devised to meet its attacks. The stationary or tidal torpedo was the earliest of the forms of this weapon. To avoid or to ward it off nothing special was done, as it appeared a very uncertain instrument, and one not likely to be often used. As steam came into more general use, the torpedo was still easier to evade, until the idea of making it move by its own or by imparted power through the water was thought of. Then it became a more serious problem. Finally, when torpedo boats were introduced as a regular type of war vessel, the subject of defense was more earnestly considered. Ships were provided with nets; their bottoms were made cellular; improved apparatus for maneuvering the nets was supplied. To-day the torpedo must, in attacking a vessel, strike against it. A distant concussion cannot be relied on. Its striking point should be under the water. Above the load line the plating is so thick that an aerial torpedo would do comparatively little harm. To get at the vessel's bottom it must dive under a torpedo net, which may run down below the keel, and after diving must rise within the area of the net and explode as it strikes the bottom. This is the best that a torpedo can do. Even then it may not sink the vessel, as one somewhat celebrated test has recently shown. Yet if it can execute this maneuver with some speed, it will do the most that a torpedo can do, and will develop to the uttermost the peculiar powers of the missile. The speed must be held as a feature adding to the destructiveness of the missile. Any increase of momentum in a large torpedo will exercise some favorable influence on its powers of destruction.

In the illustration accompanying this article we show a torpedo system possessing many features of interest. It seems to be an advance, and a novel way of dealing with the torpedo net, similar in some respects to the pair of connected automobile torpedoes already devised for this end, and due to the same inventor. This system is far more practical, however, in the sense that isolated torpedoes are always uncertain. It is the invention of General Berdan, now of Washington, D. C., already well known for his inventions and improvements in torpedo practice. One of these, the one just spoken of, has already been illustrated in our columns.* The present invention may be termed its development.

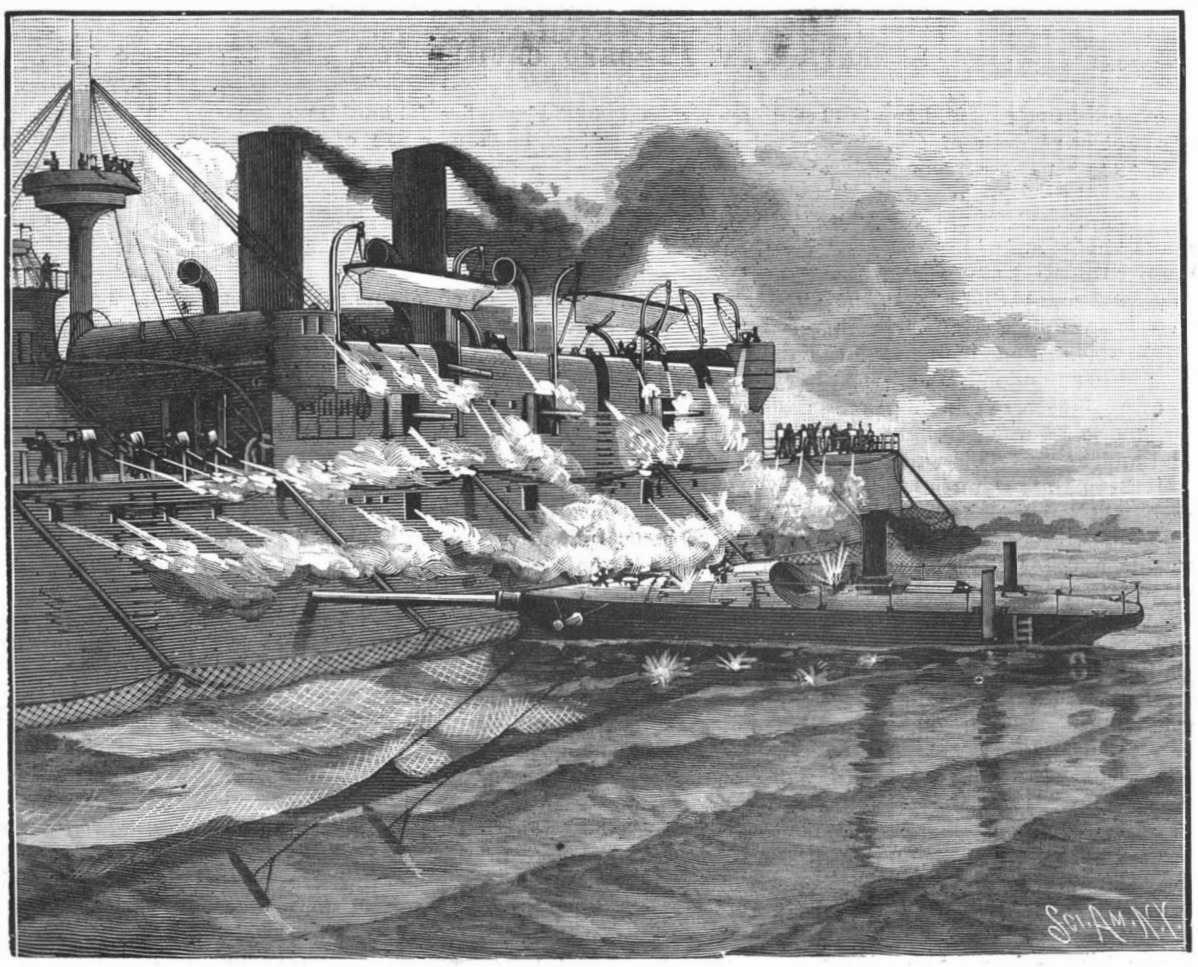
A torpedo boat is fitted with two or more tubes that overhang the water far aft on either quarter. Their axes are approximately vertical. Each one holds a torpedo. From either torpedo a stout line is carried forward, and the ends are attached on starboard and port to snubbing posts that project over the water like catheads. If the torpedoes were fired from their tubes they would naturally descend, but by the rope would be forced to follow the arc of a circle, like the stone in a sling. The radius of this circle would be the length of the rope. The torpedo boat is fitted with a pole in the place usually occupied by the bowsprit. This projects a suitable distance from the bow, and is so arranged that if its end is pressed inward it will ignite the explosive and thereby expel the torpedoes. The latter do not depend entirely upon the original impulse for their speed. They are to be provided with four tubes containing rocket composition, each 6 inches in diameter and 32 inches long, with a 2 inch hole bored through the center of the composition, so as to expose a large burning surface. The composition in the tubes is ignited by the discharge, and forces the torpedoes through the water with greatly increased speed. It is calculated that their velocity may be as high as 30 knots an hour after and during immersion.

The mode of using the system will be clear from what has been said. The torpedo boat, with her torpedoes in place, steams toward the vessel she is to attack. Her effort is to strike the discharging pole against it, by a species of ramming. This she must be able to do by being of high speed and easily handled. The instant she strikes the enemy the pole is driven back, and the torpedoes are discharged from their tubes. They dive down into the water nearly vertical. As they enter, the rocket powder begins to burn, and they swing around the arc of a circle with great speed, diving down under the torpedo net, rising within it, and striking the ship's bottom. The blow, by a percussion apparatus, explodes them, and the ship in almost any conceivable case would sink. All the conditions tend to the greatest possible efficiency of the torpedo s.

By adjusting the length of the pole, their period of release and discharge may be regulated. The inventor contemplates also the use of electricity or other supplemental means of firing them from the tubes, to be used in cases where it seems undesirable to wait for actual contact, or where it seems preferable to dispense with the discharging pole.

The tubes may be arranged a little off the vertical, so as to spread the torpedoes in their course. The system is not necessarily confined to a pair, as four or more may be used.

The connection with the snubbing posts is so arranged that should a torpedo miss the attacked vessel the fastening will give way as it rises to the surface, and it will fly away from the torpedo boat. In attacking a vessel at an angle, the outer torpedoes are disconnected and not discharged. The tubes from which the torpedoes are fired need not be very strong. They are made of metal heavy enough to resist machine guns. They are only calculated to impart an initial velocity of 50 feet per second. To prevent too severe a shock on striking a vessel, a pneumatic rammer is provided, capable of gradually resisting the impact for a range of about eight feet. The vessel otherwise is to be ram built, and to be provided with quick reversing gear for the screw. Smaller boats can be used as torpedo boat destroyers, in addition to large and powerful vessels for attacking ships. The size of the torpedoes as proposed is 8 feet long and 14 inches in diameter. They are to be charged with 200 pounds of compressed guncotton.



THE BERDAN TORPEDO BOAT.

*See SCIENTIFIC AMERICAN, vol. liii, No. 13, p. 196.

Express Company's Liability—Loss of Package.

The Supreme Court of Pennsylvania recently affirmed a judgment of the Philadelphia Court of Common Pleas, sustaining a verdict for the plaintiff in the case of Holmes vs. Adams Express Company. In this case the plaintiff got a verdict for the full value of a lost package, although no value over $50 had been assigned to it and although the plaintiff offered no further proof of negligence on the part of the company than the non-delivery of the package. The Supreme Court said, in giving judgment in the case: If goods are lost or injured while in the custody of an express company, in the absence of evidence which rebuts the presumption of negligence it will be presumed that the loss or injury was occasioned by the company, and it will be liable for the actual value of the goods. In the present case no explanation was given for the failure to deliver the goods. So far as it is proved, they may still be in the hands of the company and withheld from the owner.

Mechanical News describes an ingenious means of repairing a break in a steam pipe: The break is bound with wood strips, laid close together, and well served around with stout cord or rope. Endwise separation is prevented by more rope crossing the break diagonally, and tied so as to draw the broken parts together. When the wood and the cord get wet with the steam, the joint is even tighter than before, for the wood swells and the cords shorten.

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JAMES DWIGHT DANA.

BY MARCUS BENJAMIN.

The first distinct beginning of the science of mineralogy in the United States is referred back by Prof. Geo. J. Brush to an association formed in the city of New York, which assumed, as they expressed it, "the name and title of the American Mineralogical Society." Some years later, the elder Silliman writes that in 1803 "it was a matter of extreme difficulty to obtain, among ourselves, even the names of the most common stones and minerals."

The most important of the early American mineralogists was Dr. Archibald Bruce, of New York city, a graduate of Columbia College in 1797, and of medicine at the University of Edinburgh in 1800. Dr. Bruce established in his native city, in 1810, the *American Mineralogical Journal*, the first purely scientific periodical ever published in America.

Meanwhile, Col. George Gibbs, a young man of wealth, returned from Europe in 1805 with the first extensive and valuable collection of minerals ever brought to the United States. He early formed a friendship with Prof. Silliman, who had been elected to the chair of chemistry and natural history at Yale College in 1802, and proposed during the winter of 1809–10 to open his cabinet, consisting of upward of 20,000 specimens, provided that the college would fit up rooms for its reception. This collection, owing to the unsettled condition of the United States on account of the difficulty with England at that time, was not exhibited until a few years later. It at once gave a powerful impetus to science throughout the land, and was visited by travelers from every part of the Union. In 1825 it became the property of Yale College.

Such was the condition of this new science when the subject of our sketch was born. To him probably more than to any one single individual in the United States is the subsequent development of American mineralogy due.

James Dwight Dana was born in Utica, Oneida County, N. Y., on February 12, 1813. His early life was spent at home, and his first studies were made at school in Utica. At the age of seventeen, he was attracted to New Haven by the reputation of the elder Silliman, who at that time stood foremost among American scientists, and whose influence toward the advancement of science was felt throughout the entire country.

In the autumn of 1830 he entered Yale, and was graduated three years later. During his career in college he showed a special fondness for the natural sciences, however, without neglecting the languages or mathematics; indeed, in the latter branch he distinguished himself.

Soon after graduating, he received the appointment of teacher of mathematics to midshipmen in the United States Navy. During the two years which he held this office he visited the seaports of France, Italy, Greece, and Turkey while on the war vessels Delaware and United States.

In 1835 he returned to New Haven and became assistant in chemistry to Prof Silliman, succeeding Prof. Oliver P. Hubbard,* who then became professor of chemistry in Dartmouth College. He was engaged at this time in the preparation of his "Treatise on Mineralogy," the first edition of which, an octavo volume of 452 pages, was published in 1837.

In December, 1836, he was appointed mineralogist and geologist of the United States exploring expedition then about to be sent by the national government to the Southern and Pacific oceans, under the command of Captain Charles Wilkes. This expedition, consisting of five vessels and a store ship, sailed from Norfolk, Va., on August 18, 1838, with Mr. Dana on board of the Peacock, and visited Madeira, the Cape Verde Islands, Rio de Janerio, Terra del Fuego, Valparaiso, Callao, the Paumotou group, Tahiti, the Samoan group, Wallis Island, and Sydney in New South Wales. Leaving the latter port in December, 1839, important discoveries were made in the Antarctic regions, and during 1840 the Feejee group of islands were explored, the Hawaiian island visited, including the celebrated volcano of Mauna Loa.

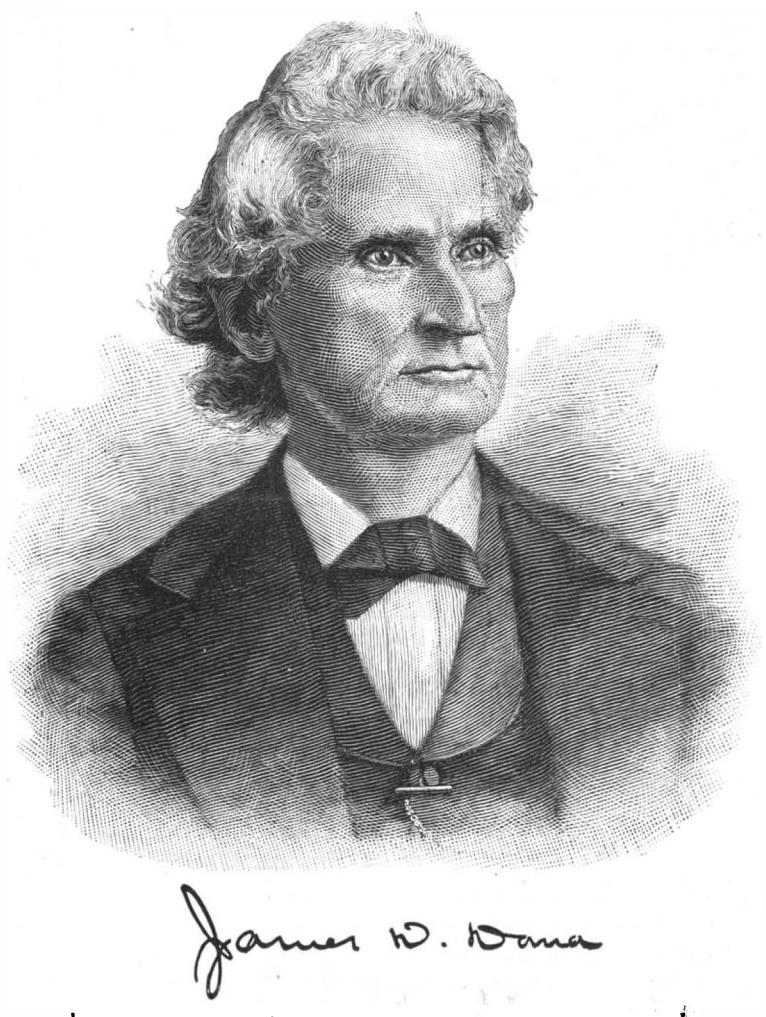
In 1841 the northwest coast of North America was visited, and the mouths of the Sacramento and Columbia rivers examined, at the latter of which the Peacock was wrecked. Finally, on November 1, 1841, the expedition left San Francisco for home by way of Manila, Sooloo, Borneo, Singapore, Cape of Good Hope, and St. Helena, reaching New York on June 10, 1842, after having entirely circumnavigated the globe. Besides the mineralogy and geology of the expedition, Mr. Dana had under his supervision the zoological department, including the crustacea and corals. The rare opportunities which this voyage afforded for scientific observation had been well improved, and for thirteen years after his return he was engaged principally in studying the material that he had collected, making drawings, and preparing the reports for publication.

From 1842 till 1844 he resided in Washington, and then removed to New Haven, where, soon after, he married Henrietta Frances, third daughter of Prof. Silliman, and has since continued to reside.

The results of his labors are given in three quarto volumes published by the government, of which but 100 copies of each were issued. The first volume was his "Report on Zoophytes" (740 pages, with an atlas of 61 folio plates, Washington, 1846), and in this work Mr. Dana reviewed the whole department of polyps, combining his own observations with those of earlier authors, and proposed a new classification, bringing for the first time the actiniæ and the alcyonoid polyps into their true relation to the astræoid polyps. He also described two hundred and thirty new species in this volume.

The second of the series was the "Report on the Geology of the Pacific" (756 pages, with an atlas of 21 plates, 1849), and gave a description of the geology of parts of Australia, western America, and the islands of the Pacific; also treating at length, with original views, on volcanic phenomena, coral reefs, and the general features of the globe.

The final volume, in two parts, was his "Report on Crustacea" (1,620 pages, with an atlas of 96 folio plates, 1852–54), and containing a description of six



hundred and eighty species, of which all but twenty-two were new. Special attention was devoted to the subjects of classification and geographical distribution in this last work. With few exceptions, the drawings in these atlases were made by Mr. Dana himself.

In 1850, Mr. Dana was appointed Silliman professor of natural history and geology, succeeding his father-in-law, but did not enter on the active administration of the chair until 1856. Prof. Silliman, referring to this event in his memoirs,* writes: "It is a signal favor that I have lived to see my two extensive departments divided, and, without any influence of mine, my own son (Benjamin Silliman, Jr.) charged with chemistry, and my son-in-law with the mineralogy and geology; and I am still in health of body and mind to enjoy this happy result." The subsequent delivery of the lectures n natural history by others led to a change in the title of the professorship, in 1864, to that of geology and mineralogy, and these branches are still in charge of Prof. Dana.

About the time of his appointment as professor, Mr. Dana became associated in the editorship of the *American Journal of Science and Arts*, established by Benjamin Silliman in 1818, and subsequent to the death of its founder he became its senior editor, and now, in conjunction with his son, Edward S. Dana, continues its publication. This journal, at present in its one hundred and thirty-third volume, is well known as the oldest American scientific journal now in existence, and is the great repository of the scientific labors of American investigators.

Contemporaneous with his duties as a lecturer and editor, Prof. Dana prepared his well-known text-books on mineralogy and geology. His "System of Mineralogy," originally published in New Haven in 1837, has grown from a single volume of 452 pages, through successive editions, until the fifth revision, issued in New York in 1868, contains 886 pages. The "Manual of Mineralogy," which first appeared in New Haven in 1851, is now in its fourth edition. Prof. Dana's "Manual of Geology," published in Philadelphia in 1863, reached its third revised edition in New York in 1880, and his "Text-Book of Geology," originally issued in Philadelphia in 1864, has been revised four times, the last in 1883. These four books are recognized as standards throughout the world, and are used as text-books and works of reference wherever the sciences of which they treat are taught in the English language. Soon after his return from the exploring expedition, he published a book entitled, "Coral Reefs and Islands" (New York, 1853), which was a reprint of a chapter from his official report on this subject to the government. A second edition of that book appeared in 1872, as "Corals and Coral Islands." He is accepted as authority on this subject, and one of his latest published papers is on the "Origin of Coral Reefs and Islands."* Prof. Dana's most recent publication in book form is "The Geological Story Briefly Told" (New York, 1875).

His separate papers include hundreds of titles, and according to President Daniel C. Gilman, of the Johns Hopkins University, "are probably unsurpassed in extent and value by those of any American philosopher." Of these a series of four articles, entitled "Science and the Bible," appeared in the "Bibliotheca Sacra" in 1856–57, and were called forth by a work of Prof. Taylor Lewis on the "Six Days of Creation," and at the time of their publication excited considerable interest. It is proper to mention in this connection that Prof. Dana is an orthodox member of the Congregational Church in New Haven, and does not altogether accept the Darwinian hypothesis. In all matters of advanced scientific thought he is exceedingly conservative.

Honors have come to him. The degree of Ph.D. was conferred on him in 1872, at the fourth centennial celebration of the University of Munich, and in 1886, at the Harvard celebration, he received an LL.D., a similar degree from Amherst College having been bestowed on him in 1853. The Geological Society of London conferred on him its Wollaston medal in 1872, and in 1877 he received the Copley gold medal from the Royal Society of London. He is a member of the American Academy of Sciences and Arts in Boston, of the Philadelphia Academy of Natural Sciences, and of the New York Academy of Sciences. He was one of the original members of the National Academy of Sciences, and has been a member of many of its important committees. Prof. Dana is a member of the Royal Society of London, the Royal Academy of the Lincei in Rome, the Institute of France, the Royal Academies of Science in Berlin, Munich, St. Petersburg, and Vienna. In 1854 he was elected president of the American Association, and in August of the following year delivered his retiring address at the Providence meeting. His shorter papers have appeared, in addition to the sources mentioned, in the "Proceedings of the American Academy," "Transactions of the Lyceum of Natural History of New York," and in the "Proceedings of the Academy of Natural Sciences of Philadelphia." It has been well said that "Prof. Dana combines with the habit of close and accurate observation powers of mind which place him in the very foremost rank of philosophic naturalists."

No sketch of Prof. Dana as a scientist would be altogether complete without some reference to his son, who so ably follows in his footsteps.

Edward Salisbury Dana was born in New Haven, Conn., on November 16, 1849. He was graduated at Yale in 1870, and six years later received the degree of Ph.D. from his alma mater, having meanwhile, however, studied abroad at the Universities of Heidelberg and Vienna.

In 1874 he was appointed tutor of mathematics at Yale, and in 1879 elected assistant professor of natural philosophy and astronomy. Soon after his return from Europe, he became associated with his father in the editorial work of the *American Journal of Science*, and at present is part owner of that journal.

Dr. Dana's great specialties are mineralogy and crystallography, in both of which subjects he has few, if any, equals in the United States.

In 1874 he was appointed curator of the mineral cabinet of the Peabody Museum of Yale University, and in 1885 was elected a trustee of the institution. He is already a member of various scientific societies, and in

*It is interesting to note that these gentlemen subsequently became brothers-in-law.

* "Life of Benjamin Silliman." By George P. Fisher. Vol. ii., p. 238. New York, 1866.

* *American Journal of Science*, August and September, 1885.

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1884 was elected to membership in the National Academy of Sciences.

Besides frequent memoirs on mineralogical and kindred subjects contributed to scientific journals in the United States and Europe, he has published "Appendix II." (1875) and "Appendix III." (1883) of Dana's "System of Mineralogy" (New York); "Text-Book of Mineralogy" (1877, and revised edition 1883); and "Text-Book of Mechanics" (1881).

The Retirement of Professor Tyndall.

Prof. Tyndall has presented his resignation to the managers of the Royal Institution, and it has been accepted with expressions of sincere regret. His age hardly furnishes a justification, as he is only sixty-seven years old. In his letter of resignation he assigned the uncertainty of his health as the cause of his retirement, stating that it would be unjust to permit the fortunes of the Institution to depend on the caprices of his health. He stated that he was so fully prepared to go on with his work that he had made arrangements to go to Paris and purchase apparatus, when he was suddenly seized with an attack of intense sleeplessness. While anticipating full and complete recovery, he felt it his duty to resign. In June, 1853, he received his appointment as professor of natural philosophy in the Institution, and in 1867, a year after the death of Michael Faraday, he succeeded him as its superintendent. His work has taken largely the direction of the popularization of science. His original investigations, while of interest and value, were not as extensive relatively as was his work in other fields. Thus his books on science have had almost phenomenal success, while as a lecturer he was, as regards his audiences, almost without a rival. His lecture tour in this country in 1872 will be remembered by many, and his generous donation of its results, $13,000, to the establishment of a fund for promotion of the study of the natural sciences in America, will ever entitle him to the regard of our people. He acted frequently as the assistant of Faraday. The latter in 1813 had been appointed assistant to Sir Humphry Davy, then professor of chemistry in the recently founded Royal Institution. This was Faraday's first connection with the Institution, over which he ultimately presided. Thus Tyndall forms the last link in the unbroken chain. His successor will do well if he can sustain the reputation of the chair hitherto so ably filled.

As a mountain climber, Prof. Tyndall won renown also, his ascent of the Matterhorn in 1868, preceded by his ascent of the Weisshorn seven years earlier, being achievements of high merit. For many years he annually visited the Alps. He became connected with the Trinity House in 1866, and has done some excellent work in the investigations demanded by lighthouse service, such as the "transparency" of the atmosphere, foggy and clear, to different sounds, such as bells and the steam siren. On retiring he has refused to accept any pension. The directors have requested him to sit for a marble bust to be preserved in the halls of the Institution, have appointed him honorary professor, a title previously borne by Sir Humphry Davy and Prof. Brande, and have decided that one of the annual course of lectures shall be termed the Tyndall course in his honor. Lord Rayleigh was nominated as his successor, the election to take place on May 9. His appointment to the chair will confer on it additional luster, as this eminent physicist may be safely ranked with two or three others as the foremost of the profession.

Plates for Wimshurst's Machine.

My method of piercing these machines is as follows: A disk of iron, 3 in. diam. and ¼ in. thick, with a hole in the center, of the size required in the plates, is cemented to the center of a circular glass plate by softened glass pitch (ordinary pitch with a little turpentine added while warm), the glass and the iron disk being previously warmed. When quite cold, the plate, with the disk attached, is immersed in water to prevent vibration, while the center is broken through, first by driving the tang end of a file through in several places, and afterward by nibbling the glass away with a small hammer until the hole is of the right size. This hole can then be smoothed by a file or a piece of grindstone. The iron disk is now to be detached by a gentle heat to soften the pitch, and the glass cleaned with a little turpentine on a piece of rag. I can do five plates in one hour by this process, and recommend amateurs to try it.—*C. A. Lowe, in English Mechanic.*

A COMMON trouble with us all is that we fail in our business because we think little of it. No man truly succeeds in any calling who has a poor opinion of it. No man has a good opinion of his business who uses it only to make money out of it. No man can have the best conception of his business who does not esteem it for its usefulness. And the higher we go—if "higher" and "lower" are proper terms to use in considering the different honorable and useful walks of life—the more clearly will it appear that he who only esteems his business for the living or money that is in it must, if judged by any high standard, be a failure.—*Dr. Hapgood.*

SCIENCE IN TOYS.

x.

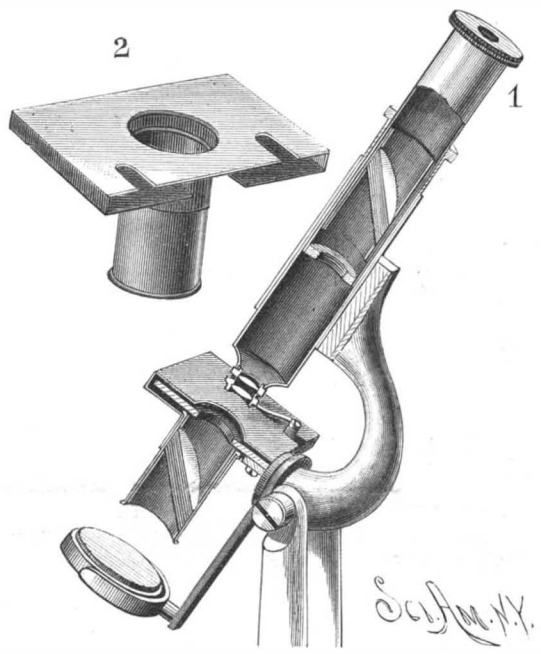
SIMPLE POLARISCOPE FOR THE TOY MICROSCOPE.

The possessor of an inexpensive microscope like that shown and described on page 246 of the current volume of the SCIENTIFIC AMERICAN, or, in fact, of any other microscope not provided with a polariscope, will feel well repaid for his labor if he will construct and apply to his instrument a polariscope like that shown in the annexed engraving. The cash outlay for the material is 25 or 30 cents, and only an hour or so of time is required to complete the attachment.

To the draw tube of the microscope is fitted a paper tube, which is readily made by gumming writing paper and winding it around a cylindrical stick of the proper size. To the paper tube is fitted a second tube, and this last tube is cut diagonally through the center at an angle of 35° 25′. One of these pieces is inserted in the first tube, and sixteen or eighteen elliptical glass covers, such as are used for covering mounted microscopic objects, are placed on the diagonally cut end of the inner tube.

The glasses should be thoroughly cleaned, and when in position in the tube they are held by the remainder of the diagonally cut tube. The sectional view of the instrument clearly shows the position of these glasses in the draw tube.

The tube which goes under the stage is made in precisely the same way, and is supported in position for



SIMPLE POLARISCOPE FOR THE MICROSCOPE.

use by a short paper tube secured to a cardboard casing adapted to slide over the stage of the microscope, as shown in the engraving. Notches are formed in the rear edge of the upper part of the casing to allow it to slip by the slide-holding clips, as shown in Fig. 1. The lower tube must be capable of turning in the short fixed tube, and it may be prevented from falling out by gluing a cardboard band or a piece of small cord around its upper end, forming a sort of flange. The hole in the upper part of the casing is made larger than the movable tube, to admit of inserting the tube from the top of the casing. The part of the attachment below the stage is the polarizer. The part in the draw tube is the analyzer.

By turning the polarizer, the light being thrown directly up the tube by the mirror, the field of the microscope will appear alternately light and dark, showing the partial extinguishment of the polarized beam twice during each revolution of the polarizer.

When the field is darkest, a piece of mica of the proper thickness inserted between the stage and objective renders the field light, and it may produce a color effect, in addition to its depolarizing effect. The colors depend on the thickness of the film or upon its position in the instrument.

There are various chemical salts and animal and vegetable substances which produce brilliant color effects in the polarized beam. Salicine is a favorite. Santonine is good. Tartaric acid, boracic acid, and cane sugar are easily prepared by allowing their solutions to crystallize on the glass slip. Some of these substances, salicine for example, may be fused upon the slip and recrystallized.

The colors may be heightened by placing a film of mica behind the object during examination. Different colors will be produced by different thicknesses of mica.

Among animal substances to be examined in this way are fish scales, parings of the finger nails and of horses' hoofs, parings of corns and of horn.

Among vegetable substances, the sections of some woods, the cuticle of plants, the rush for example, form good polariscope objects.

Many minerals show well in polarized light, but they are generally difficult of preparation. Selenite is an exception. It may be readily reduced to the proper thickness to secure brilliant effects.

The polariscope above described, although not as desirable as one provided with a pair of Nicol prisms, is nevertheless worth having, and will give its possessor a great deal of satisfaction. G. M. H.

The Value of Water Gas in Heating and Smelting Operations.

In a recent number of *Dingler's Polytechnisches Journal* are given the results of some interesting experiments carried out at Frankfort-on-the-Main with the object of testing the value of water gas for heating and smelting purposes. It was found that this gas, made in a Wilson generator, and having the following percentage composition: Carbonic oxide, 18; hydrogen, 10; nitrogen, 68; carbonic acid, 4; was serviceable for the heating of boilers, but unfit for smelting purposes. The melting temperature of silver could hardly be reached, the gas having lost its generating temperature of 400° C. by the transit from the generator to the furnace. By utilizing this temperature and heating the air of combustion, the ordinary smelting operations could be performed; nevertheless, the use of the Wilson generator was discontinued, because the gas was not cheaper than other fuel for boiler heating.

Since 1885 the refining works at Frankfort have used water gas, furnished by the neighboring gas works at 6 pfennige per cubic meter, or about 1s. 8d. per 1,000 cubic feet. It is not stated by what process the gas is manufactured; but in composition it is identical with the Lowe gas. It is still too expensive for all crude purposes, so that it is only used in melting gold, silver, and their alloys, fluxes, and pigments for the decoration of china, and all purely laboratory work. It was compared with the rich illuminating gas obtained from the Frankfort works, and the poorer gas supplied in the city, the burners used being identical. A copper vessel, filled with water, was heated from 15° to 100° C., under similar conditions. It took 10 cubic meters of water gas against 4 cubic meters of Frankfort rich gas, and 5 cubic meters of the poorer gas. Equal weights of two kinds of flux for enameling colors were melted under identical conditions, in a Perot furnace. The cost of the gas in each operation was 4·60 and 6·50 marks for water gas, against 19·6 and 26·8 marks for the rich Frankfort gas.

Equal quantities of fine silver and copper were melted with the two gases in the same furnace. It required of water gas 4·30 and 5·70 marks' worth, and of rich illuminating gas 16·7 and 21·7 marks' worth. By using water gas, therefore, all boiling, heating, or evaporating operations can be accomplished for half the money, and all melting for about a quarter the money, as compared with illuminating gas. It will be seen that this is only the result of the difference in the price of the two gases; for from the first experiment it follows that the pyrometric value of the coal gas is 2·5 times as high as that of the water gas.

A Chemical Entertainment.

A correspondent of the *Chemist and Druggist* says he "was asked to entertain a number of school children with chemical amusements, and chose out of the list such as were most suitable for public exhibition. Others were suggested by what I read. It may save some of your readers time and trouble, when looking up similar work, if I give a list of what were found feasible and successful in my own case:

The Magician's Kettle, which supplied twelve liquors of different color. Of course, the coloring agents were in the glasses—aqua pura in the kettle.

Witch's Caldron.—S. v. meth. with boric acid; stront. nit., etc., in suitable vessels.

Blazing Ice.—Potassium and ice.

Lighting a Candle with Ice.—Put a piece of potassium in the wick.

Fire under Water.—Phosphorus, pot. chlor., and acid sulph.

Dancing Fire Ball.—Charcoal ball on pot. chlor., fused in test tube.

Lightning.—Lycopodium blown into a flame by insect powder bellows.

Ice Creams.—Silicate of soda and chloride of calcium.

Sunlight.—Magnesium ribbon burning in oxygen.

Moonlight.—Phosphorus in oxygen.

Will-o'-the-Wisp.—Phosphorized ether in hot water.

Turning Steel into Copper.—Dipping boy's knife into sol. cup. sulph.

Volcanoes.—Pot. chlor. and sugar, inflamed with ac. sulph.

In addition to these experiments, a gas factory was in work, by making hydrogen, passing it through benzine, and igniting. A lead tree was "planted," and grew. But the most captivating of all was the *Magic Likeness Taker*. Comic figures were drawn on white paper with gallic acid and mucilage. The sheets, apparently clean and untouched, were hung up, and the pictures developed by spraying on them a solution of iron sulphate.

All these may be carried out by any chemist at very little expense."

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POLARIZED LIGHT.

BY GEO. M. HOPKINS.

VI.

SUGGESTIONS IN DECORATIVE ART.

Occasionally, evidences of the use of the microscope in decorative art are seen, and every microscopist knows that there are thousands of beautiful forms lost

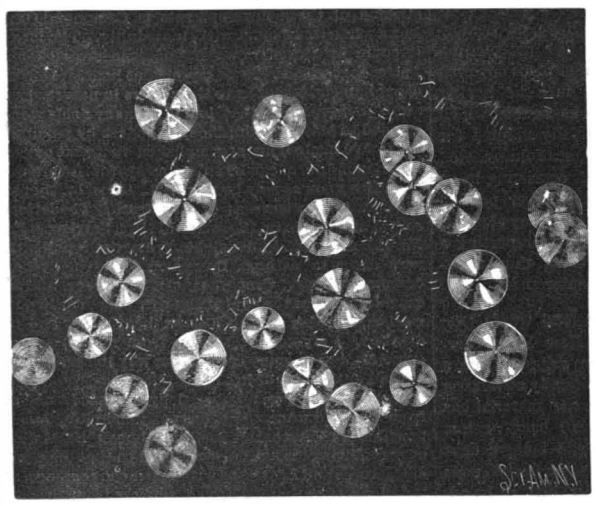

Fig. 1.—SALICINE CRYSTALS.

to unaided human vision which are revealed only to the user of the microscope. These minute forms are always exquisite in their construction and finish, often symmetrical and graceful in form, and quite as often finely colored. All this is true of microscopic objects in general, but it is especially true of polariscopic microscope objects. Some of these are, to a certain extent, artificial. The crystals, for example, are the result of manipulation, but the laws of crystallization are

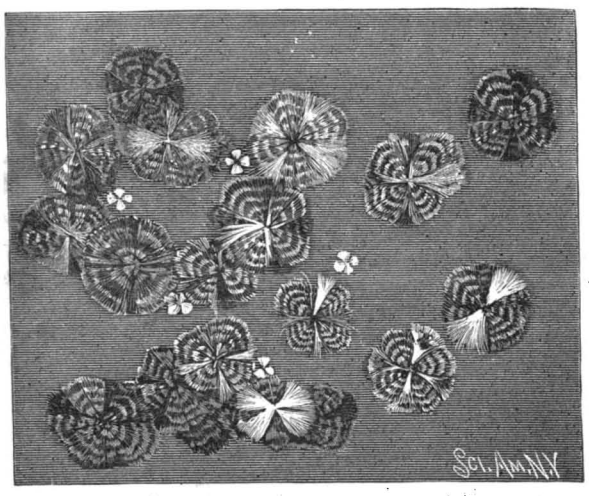

Fig. 2.—SULPHATE OF CADMIUM.

natural, so that, after all, we are indebted to nature even for these objects.

In the present instance, a few striking examples of crystallization have been selected as the basis of some suggestions in decorative art. These crystals, as exhibited by polarized light in the microscope, are shown in the annexed engravings, necessarily divested of their principal charm—that of color. The forms only are shown. The reader can imagine these figures invested with the most gorgeous colors of the spectrum combined in a perfectly harmonious way. In respect to color, the polariscope never errs. Whatever colors are presented are correctly related to each other. This feature alone is of great value to the designer and colorist. The circular crystals of salicine, shown in Fig. 1, are always interesting. The play of the radial bands of color as the polarizer or analyzer is revolved

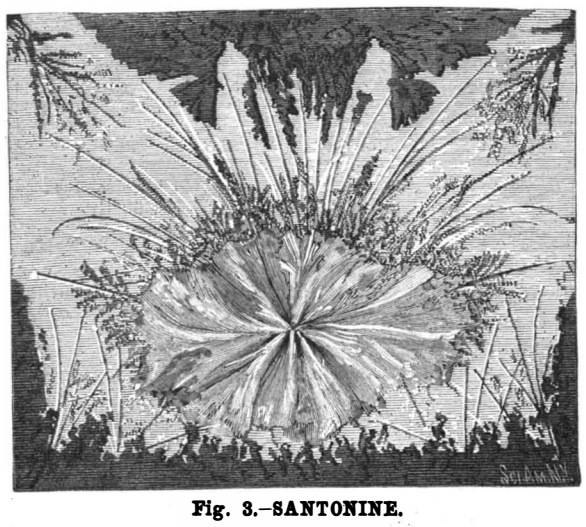

Fig. 3.—SANTONINE.

gives each disk the appearance of having an actual rotation of its own.

In Fig. 2 are shown the delicate, feathery crystals of sulphate of cadmium, in which the coloring, as exhibited by polarized light, is scarcely more beautiful than the exquisite forms. The shapes of the different crystals vary somewhat, but there is a characteristic feature pervading them all.

In Fig. 3 are shown crystals of santonine in a variety of forms—some like spears of grass, others resembling heads of grain, and still others like ferns and various leaves, while the larger crystals or aggregation of crystals has a radial arrangement.

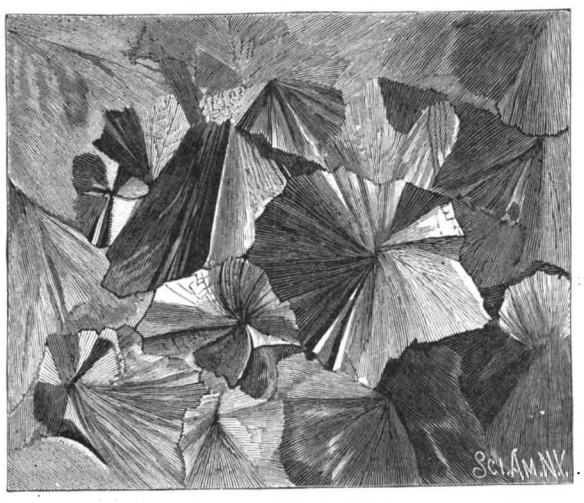

Fig. 4.—LITHIC ACID.

In Fig. 4 are shown crystals of lithic acid, which adjoin each other, and form a solid field, having strongly contrasting bands of light and dark color.

Fig. 5 will be recognized as a part of a dado, frieze, or border, formed of lithic acid as a ground, crystals of platino-cyanide of barium as the division of the panels, and crystals of sulphate of cadmium as rosettes upon the centers of the panels.

Fig. 6 shows a panel formed in part of the same

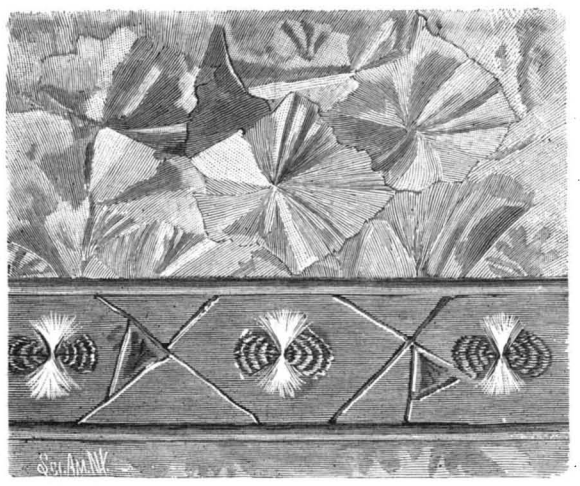

Fig. 5.—BORDER DADO OR FRIEZE.

crystals, with a crystal of salicine planted at the intersection of two of the slender platino-cyanide of barium crystals, and small crystals of kinate of quinia forming flowers.

In Fig. 7 is shown a border formed of crystals of santonine, arranged on a ground of neutral tint, with a row of circular crystals of sulphate of copper and mag-

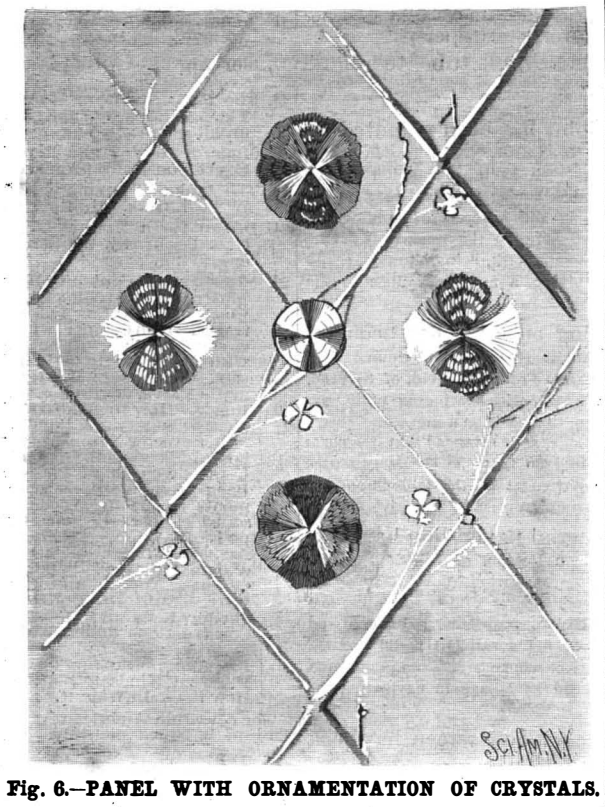

Fig. 6.—PANEL WITH ORNAMENTATION OF CRYSTALS.

nesia above a row of crystals of kinate of quinia, arranged on a dark ground.

Fig. 8 shows a pattern having a background of stearic acid, branches of platino-cyanide of barium, leaves of platino-cyanide of magnesium, and flowers of salicine.

What has been shown in the engravings constitutes only a hint of what may be done in this direction. The number of beautiful crystals and other polariscope objects available for this purpose is very large.

Flavoring Extracts.

Cooks, confectioners, and others engaged in the

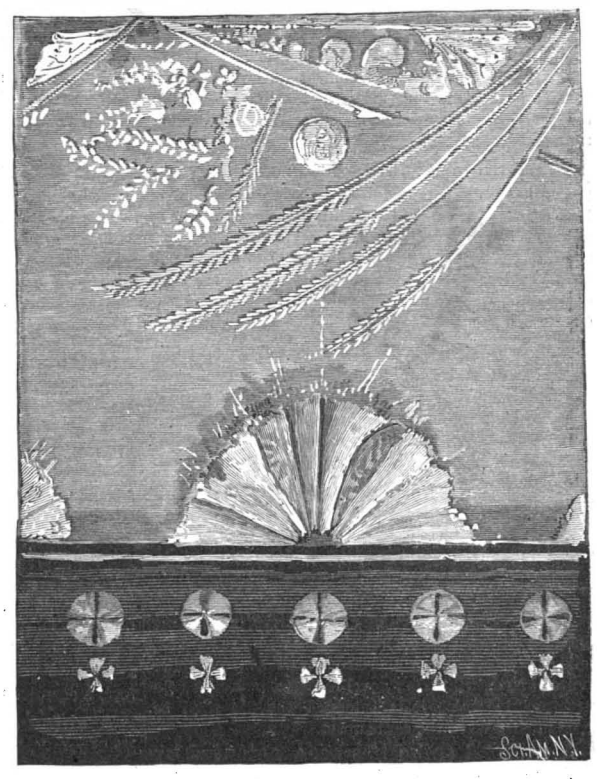

Fig. 7.—A COMPOSITE BORDER.

preparation of foods and drinks are in the habit of using various artificial perfumes, which in chemical language are such bodies as amylic valerianate, amylic butyrate, ethylic butyrate, propylic ether, and caprylic alcohol. The odor and flavor of the apple, the pear, the pineapple, the strawberry, and the raspberry can thus be imitated. The imitations not only remove the necessity for the use of the natural fruits, but are less expensive, and, besides having perfect similitude with them, give the appropriate flavor in a more accentuated form.

MM. Poincare and Vallois have sought to ascertain whether these artificially prepared perfumes possess poisonous properties by injecting them under the skin of animals, as well as introducing them into the stomach. Dogs and guinea-pigs can withstand even large doses of these substances when injected under the skin; but these animals can be poisoned by sufficiently large doses, and then the symptoms set in rapidly. The most constant toxic symptom was great prostration, which was followed in a variable time by coma. These phenomena were less marked in the dog than the guinea-pig. All the animals were troubled with violent nasal irritation and sneezing, and distressed breathing was always evidenced by over-action of the respiratory muscles. An excessive secretion of mucus from the bronchial tubes was also noticed. Notwithstanding the gravity of the symptoms, the majority of the animals recovered. The practical outcome of these experiments is to sanction the use of infinitesimal doses, such as are already employed for artificial flavoring of aliments.—*Zymotechnic Magazine.*

Simple Method of Distinguishing the Terminals of a Dynamo.

To the two binding screws or to wires leading therefrom, lead wires are connected. This simple voltame-

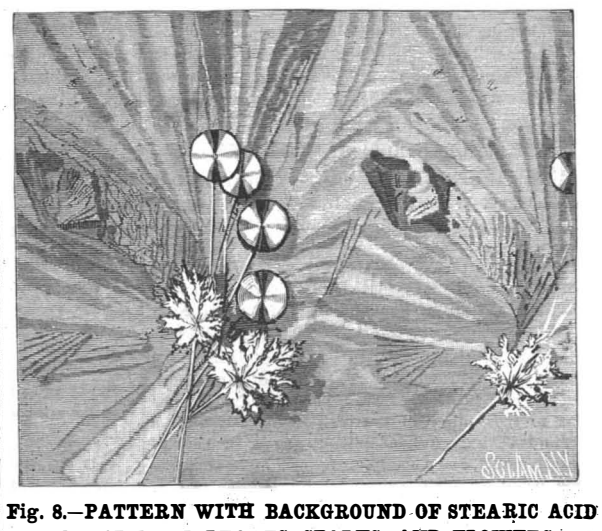

Fig. 8.—PATTERN WITH BACKGROUND OF STEARIC ACID AND CRYSTAL LEAVES, STALKS, AND FLOWERS.

ter is immersed in sulphuric acid. After a few seconds the positive electrode becomes covered with a brown coating of peroxide of lead, while the negative electrode becomes white and metallic in appearance.—*L'Elettricita.*

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ENGINEERING INVENTIONS.

An injector has been patented by Mr. Ferdinand Brunbauer, of Vienna, Austria. It is so constructed as to be always gradually started, no matter how it may be operated, having a fixed outer steam tube, a concentric endwise movable inner steam tube, forming a ring-shaped passage between them, a valve within the inner tube, and other novel features.

A railway signal has been patented by Mr. Pierson J. Wicks, of Greenpoint, N. Y. The invention relates to electric signals for block systems, and consists of three conductors, of which one is continuous and supplied from a central station, supplying current to the propelling motor and also for operating the electric signal to sound an alarm when two or more trains are in adjacent sections.

A portable switch table and car replacer has been patented by Mr. Arthur Durieu, of New Orleans, La. It is for facilitating the replacing of cars and locomotives on the tracks in case of derailment, and is to be carried on all trains; it consists of simple devices to be placed on the sleepers at the sides of the rails, and firmly clamped thereto, on which the wheels will run up and down, as on an ordinary rail.

A car coupling has been patented by Mr. James H. Davis, of Danville, Ky. The construction is such that the end of the link may be held at any angle, and when the cars come together to be coupled a lever brings the pin instantly to position, locking the link in the drawhead, while the uncoupling may be done from the top or sides, the invention also covering various other novel features.

A water heater for cars has been patented by Mr. William A. White, of Staatsburg, N. Y. A casing of two metallic shells, with a non-conducting filling between them, incloses a fire box with grate bars, upon which a fuel cylinder discharges, a heating chamber located near communicating with the fire box, coils of pipe extending therefrom, and a water boiler located above, with other novel features, making a construction in which it is intended the fire shall be extinguished when the car is upset.

A railroad spike has been patented by Mr. Thomas A. Davies, of New York City. This invention relates to a former patented invention of the same inventor, and consists in a spike having the under surface of its head formed with two flat faces, adapting the spike to have a broad bearing upon the base of the rail, whether driven vertically or at an inclination in the cross tie, and also facilitating drawing out without bending.

A railway fish plate has also been patented by the same inventor. It is an angle fish plate made to be bolted to the webs of the rails, and to have a bearing at the outer edge of its base flange upon the cross ties, being slotted beyond the edges of the base of the rails, so that there is no lateral contact with the spikes, but the rails themselves are held from lateral movement by the direct contact of the spikes, and the fish plates have what is called "repose bearings."

A rock drilling machine has been patented by Mr. John Jennings, of Canon City, Col. This invention covers an improvement on a former patented invention of the same inventor, in a machine designed to be especially useful in drilling vertically downward, or nearly so, in which case the drill carriage may be lowered at intervals, or left to fall by gravity, as found necessary or desirable.

A car coupling also forms the subject of two patents issued to the above inventor. In one of them the drawhead has spring-actuated anchor bars, which open to receive and close upon the drawbar automatically, as the cars come together, or may be opened to uncouple the cars by an operating cam, which is worked by a shaft supported in bearings toward either side of the car, so that the coupling or uncoupling can be readily effected without going between the cars. In the other patent the coupling hook is pivoted near its rear end within the drawhead, and has its front end formed with a hook proper for engaging a shoulder on the drawbar, the coupling hook being yieldingly held down by a spring, but so as to admit the entry of the drawbar for coupling as two cars come together, there being levers extending to the sides and top of the car for working the device.

AGRICULTURAL INVENTION.

An improved plow jointer, for cutting off the edge of the furrow slice and depositing it in the previous furrow, has been patented by Mr. Thomas Lowden, of Lowell, Mich. The invention covers a simple construction, whereby it is intended that the draught of the plow shall not be sensibly increased, and the jointer will act subtantially in the ordinary form, and it is so made that it can be used as an attachment for any form of plow.

MISCELLANEOUS INVENTIONS.

A folding top for camera stands has been patented by Mr. William H. Lewis, of Brooklyn, N. Y. It is so constructed that it may be folded into a vertical position and made to occupy a very contracted space, and so that great stability and strength are secured and great convenience is afforded for attaching and detaching the camera and legs of the tripod or stand.

A stringed instrument holder has been patented by Mr. Rodolphus T. Fiorini, of New York City. It is an internally threaded socket adapted to be fixed to the bottom of the instrument case, with a standard having a fork adapted to receive the neck of the instrument, and a clamping device for holding the same, being especially calculated for holding violins, guitars, etc, and upon music stands used in orchestras.

A remedy for hog cholera has been patented by Mr. George H. Beckwith, of Charlestown, West Va. It consists of mandrake, sulphur, charred coffee, chlorate of potash, and other materials, prepared and administered in a prescribed way, in connection with certain simple details of treatment which the patentee has found highly effective in years of experience.

A vehicle gear has been patented by Mr. Luther Stouffer, of St. Joseph, Mo. Bolster plates or posts are secured to the head block and the rear axle, perches being supported by the bolster plates and secured to the reaches, springs connected with the perches supporting the wagon box or bed, whereby side bars are dispensed with, cross braces may be used, and the wagon wheels can turn under the reaches.

A filling apparatus has been patented by Mr. John C. Collins, of Chillicothe, Ohio. It is for filling hot salt water or other liquids into cans holding corn or other vegetables, and consists of a sliding frame holding a tray, in combination with a stationary reservoir, filling tubes extending therefrom, with valves which can be opened and closed automatically, and other novel features.

An end gate for wagons has been patented by Mr. Charles F. Bassett, of Hillsdale, Ind. It is so made that it may be applied to either or both ends, will act either as an end gate, scoop board, or dump gate, may be held or placed at any desired angle, is capable of being removed or applied at will, will prevent the sides of the wagon from spreading, and also prevents the contents of the wagon from spilling out.

A fruit drier has been patented by Mr. Sylvester Stigler, of Claysville, Ohio. Combined with apartments open at both ends are horizontal partitions with transverse slots and rearwardly and upwardly bent flanges, with drawers having upwardly bent front ends, for drying fruit, preferably by hot water, and also by steam, drying it quickly, evenly, and so that it will retain all that is possible of its fresh flavor.

A weather strip has been patented by Mr. William R. Allan, of Pittston, Pa. It consists of a weather strip hinged to the door, in one end having a roller journaled, so that as the door is closed the roller travels upon the saddle, carrying the weather strip in advance of the door, and as the door latches, the roller drops into place, the weather strip fitting so as to form a complete seal.

A chimney cap has been patented by Mr. Hiram F. Henry, of Gowanda, N. Y. It consists of a section of pipe with outwardly and upwardly projecting branches having their angle of meeting directly over the center, with imperforate deflecting cones, and other novel features, offering the least possible resistance to the smoke and products of combustion, while effectually preventing the entrance of the wind.

A door check has been patented by Messrs. Elver H. Shaw and Justin D. Wixom, of Clay Center, Kansas. It consists of a latch device to be attached to the base board or wall and a catch to be attached to the face of the door, whereby as the door is opened its catch will be automatically engaged by the latch, and may be readily disengaged to allow the door to be closed, the device being simple and inexpensive.

An apparatus for drying and cleaning ramie and other fibers has been patented by Mr. Christian C. Kauffman, of New Orleans, La. It is for use after decortication, and embraces a hot air drying chamber to solidify the gum or sap in the fiber, with cleaners adapted to mechanically remove the solidified material, and feeding devices to pass the fiber through the drying chamber and the cleaners.

The treating of ramie and other fibers also forms the subject of a patent granted to Messrs. Christian C. Kauffman and John Austin, of New Orleans, La. The invention consists in treating the fiber in a continuous manner, first to a decorticating operation, then to a drying one by artificially heated air, and afterward to a mechanical cleaning, all being performed while the fiber is in motion, and saving rehandling.

A portable stationery case has been patented by Mr. Joshua F. Tannatt, of Springfield, Mass. This invention covers a novel construction, combination, and arrangement of parts, in a case forming a general receptacle for articles used by letter writers and others, and adapted for use either on the table or by suspending it from the wall, so that no matter how it is thrown about or handled, the articles will always remain in place.

A spectacle joint has been patented by Mr. Paul Moews, of New Castle, N. Y. The invention consists of end pieces, each having a trunnion formed on its face, a temple disk having a central aperture fitting over the trunnions and a screw for holding the parts together located between the inner ends of the end pieces and the temple disk, being durable, easily manufactured, and giving a fine appearance to the spectacles.

A hand pasting machine has been patented by Messrs. Ezra T. Hazeltine and John J. Benzino, of Warren, Pa., and Frank A. Weld, of Stanton, Neb. It has a sliding table with a swinging paste box, with a disk for distributing paste on a line across sheets held on the sliding table, and arranged that the paste box may be held raised so that the sheets can pass under it during the movement of the table in one direction without receiving any paste.

A system of aerial navigation has been patented by Mr. William Beeson, of Dillon, Montana Ter. This invention covers various novel features of construction and combinations of parts relating to a system of aerial navigation, comprising a balloon and attached propelling or flying sail-suit aerial motors, whereby the influences of wind currents and gravitation may be utilized to good advantage in navigating the air.

An adjustable window screen has been patented by Messrs. Forest M. Sampson and George W. Hogben, of Ripon, Wis. This invention covers improvements on a former patented invention of the same inventors, so that guide pins separate from the springs by which the adjustable strips or plates are forced outward may be dispensed with, and the spring-pressed plates will be held snugly to the face of the main screen frame.

A carding engine has been patented by Messrs. Benjamin A. Dobson and William J. Bromley, of Bolton, Lancaster County, Eng. This invention is designed to provide improved means, where the revolving flats travel upon flexible bends, for one or both bends to be adjusted separately or simultaneously, and also to provide for automatically adjusting the front and rear carrier shafts or rollers around which the flats pass when the flexible bands are adjusted, so that the flats may be accurately adjusted at all points with reference to the main cylinder.

Interlocking bolts form the subject of two patents issued to Mr. Thomas J. Bush, of Lexington, Ky. The inventions relate to former patented inventions of the same inventor, in the first place covering straight bolts, notched to interlock, in a tie having diagonal intersecting holes, and blocks against which the nuts of the bolts bind, being especially adapted for railway ties and rails, bridge timbers, scaffolding, etc., and in the other case the improvement consisting in so forming the interlocking recess and the lower portion of one member of each pair of bolts that they shall intersect in the same plane and be locked by imparting a quarter turn to one of the pair, they being then tightened by means of screw nuts at their outer ends.

A fiber cleaning machine has been patented by Mr. Arthur W. Savage, of New York City. The material is drawn by an upper gripper from a delivery chute to a carrier belt continually advancing toward a macerating roller, and after the material has been acted upon by the roller it is drawn back against the action of the roller, the cleaned ends being caught by a lower set of gripper fingers, and the uncleaned ends thrown over upon the endless carrier belt to be advanced thereby to the macerating roller; these ends having passed between the roller and its bed, the material is again drawn back against the action of the roller and automatically dropped from the machine, while a second lot of material is drawn from the chute to be operated upon.

SCIENTIFIC AMERICAN
BUILDING EDITION.

MAY NUMBER.

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When George Stephenson, the inventor of the locomotive, was about to start out on his first trip, he declared that the water in his boiler carried a power that would revolutionize the carrying trade of the world. The same test which decided the merits of the claims for the powers of steam is a fair one for to-day. One of the most striking of these developments is Compound Oxygen. For a while it also met with incredulity. The idea that it could be stored in water and transported long distances met with the same doubt that had greeted every other new statement as to the powers in nature. But the same perseverance that had in so many fields won success led to patient endurance of the test by results; and they have made it an accomplished fact that oxygen in a compound form can be stored away for future use, to be drawn upon as may be required. Tens of thousands are now living witnesses of this truth. The letters received and on file in the office of Drs. Starkey & Palen, No. 1529 Arch St., Philadelphia, from their patients, report cures in asthma, bronchitis, catarrh, dyspepsia, eczema, epilepsy, dropsy, cancer, hay fever, heart disease, diseases of the eye, of the ear, consumption, rheumatism, diseases of the kidney, headaches, and other diseases. Nervous prostration from mental strain and overwork has in many cases given way to renewed powers and enjoyment of life.

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NEW BOOKS AND PUBLICATIONS.

REPORT OF THE BOARD OF COMMISSIONERS OF THE GEOLOGICAL SURVEY OF PENNSYLVANIA TO THE LEGISLATURE, JANUARY 1, 1887. Pamphlet. Pp. 6.

This is a report of progress. It is preceded by two charts showing what part of the State has been mapped and reported on. The text particularizes the work of the past years, and states what remains to be done. A final clause recommends an appropriation of $90,000 to carry on the work of the survey.

NINTH ANNUAL REPORT OF THE CONNECTICUT BOARD OF HEALTH, FOR THE YEAR ENDING NOVEMBER 1, 1886. New Haven. Pp. xi., 167.

In the ninth annual report of the Connecticut health authorities, we find in addition to the general reports a number of treatises on subjects of present and vital interest. A report gives the health of towns, the character of each town being reported by a special observer, in many cases physicians. This gives an admirable diagnosis of the village sanitary aspect, and upward of 70 pages are devoted to the summary. Malaria and its etiology are exhaustively treated of by Dr. R. W. Griswold. This portion of the work is of interest to all, not being limited in its scope to the State. Pollution of Streams, by James B. Olcott, the Warming of Dwelling Houses, by Dr. G. Elliot, Analyses of Well Waters, an exhaustive series of papers on diphtheria and its causes, follow. Abstracts from Report on Adulteration of Foods, by Dr. A. J. Wolff, and a report on disinfectants end the main portion of the volume. The list of subjects shows how valuable the work is to sanitarians, and the book sustains the high reputation enjoyed by the Connecticut health reports during the past.

INDIANA: DEPARTMENT OF GEOLOGY AND NATURAL HISTORY. Fifteenth Annual Report. Maurice Thompson, State Geologist. 1886. Indianapolis. Pp. 359.

The annual report of the State Geologist of Indiana treats of the mineral resources of the State and of points in its geology, mineralogy, and flora. Prehistoric man is the subject of a monograph by S. S. Gorby. Natural gas and oil wells in the State are described by Maurice Thompson, who figures as the author of a great part of the volume. In testimonial of the good work done by these reports, the director states that he has answered over 1,500 letters from outside the State, touching on subjects of the survey in his charge. The paper by Professor Gorby on the anticlinal, termed by him the Wabash Arch, is of especial importance as touching the probabilities of a gas country being discovered. The work throughout bears a practical aspect, that will tend to make it of more immediate direct benefit than a purely theoretical work would be. It will attract attention from all interested in the mineral and mining development of Indiana. A glossary of scientific terms is a good feature not often found in this class of works.

ELEMENTARY TREATISE ON DETERMINANTS. By William G. Peck. New York and Chicago. 1887. A. S. Barnes & Co. Pp. 47. Price, 75 cents.

This little work treats in a very clear and intelligible style of the subject of determinants, now becoming an essential branch for those studying the higher mathematics. The general resolution of determinants is illustrated by algebraic and arithmetical examples—an excellent method in a text-book. The multiplication, squaring, and raising to higher powers of these functions is clearly explained, and in conclusion the differential of a determinant is treated of.

NATURAL LAW IN THE BUSINESS WORLD. By Henry Wood. Boston and New York. 1887. Lee & Shepard and Charles T. Dillingham. Pp. 222. Price, 75 cents.

This little work on political economy in its more practical field treats of the labor question, of poverty, and of the kindred topics occupying so much attention at the present day, The book is too concisely written to yield its spirit to a review. In the main a conservative spirit seems to guide the writer, and his treatment of the complex subjects to which the book is devoted will, we are sure, prove acceptable to many thinkers.

CURVE TRACING IN CARTESIAN CO-ORDINATES. By William Woolsey Johnson. John Wiley & Sons, New York.

GEONOMY: CREATION OF THE CONTINENTS BY THE OCEAN CURRENTS. By J. Stanley Grimes. J. B. Lippincott & Co., New York.

THE PEANUT PLANT: ITS CULTIVATION AND USES. By B. W. Jones. Orange Judd Company, New York.

THE TOBACCO REMEDY. By Gen. T. L. Clingman. Orange Judd Company, New York.

* * Any of the above books may be purchased through this office. Send for new catalogue just published. Address Munn & Co., 361 Broadway, N. Y.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1) G. H. D. N. asks the constituents of the usual common black varnish much used as a painting on iron vessels, etc. A. Boil coal tar until it shows a disposition to harden on cooling; this can be ascertained by rubbing a little on a piece of metal. Then add about 20 per cent of lump asphalt, stirring it with the boiling coal tar until all the lumps are melted when it is allowed to cool, and is kept for use. Asphaltum and gas tar are frequently sold one for the other. The source of supply is different, but they are very similar in their results.

(2) B. O. F. asks: What is the best or safest way of reducing flesh without material injury to the body? A. Reduce the quantity of your diet and increase your walks, say to nine miles daily.

(3) J. L. asks if hot water or steam will take the temper out of a spring. A. It is possible, and sometimes occurs. Springs in cylinders of engines working under high pressures sometimes lose their temper from long exposure to the heat.

(4) G. F. W. asks how to fasten wire to electric light carbons so that the wire will not corrode when the carbons are used in a sal ammoniac battery. A. Dip the upper ends of the carbons, if they are not coppered, into paraffine, then plate them in a sulphate of copper bath with copper, and solder your wires to the copper; or you may dip the coppered ends into melted type metal, and use a clamp to hold the wire. This is far the best method.

(5) T. H. asks: Is there any sure way of detecting sewer gas except by feeling its effects? A. No sure way is known. The most reliable would be a bacterial analysis of the suspected air. The reducing action of the air upon a solution of permanganate of potash also gives a possible clew for solving the problem. Instead of testing directly for the gas, the usual practice is to examine the pipes for leakages at the joints, or for defective seals, by pouring oil of peppermint and hot water into the pipes and then tracing leaks by the odor. The oil should, if possible, be introduced from the outside and by another person. Experience is necessary to conduct the test properly.

(6) E. M. asks for a good work on dry plate emulsions. See "Photography with Emulsions," $1.00, by Captain Abney, and "Dry Plate Making for Amateurs," 50 cents, which we will mail on receipt of price. Also see SCIENTIFIC AMERICAN SUPPLEMENT, No. 541.

(7) H. E. B. asks: 1. If I take a Leyden jar and charge it with electricity, and then slip another jar not charged inside of the first jar, and connect the inside of the inner jar with the earth, will the second jar become charged? A. The inner jar will become charged. 2. Why cannot any one charge a Leyden jar by connecting the inside of the jar with the positive pole and the outside with the negative pole, and not depend on induction for charging one side of the jar? A. The jar can be so charged, and the Holtz machine is very conveniently used in this way to charge jars. 3. What is a cascade in electrical parlance? A. A cascade of Leyden jars indicates their arrangement in series, the inner coating of one communicating with the outside of the other; during the charging process, the jar at one end has one coating, generally the inner, connected with the machine, while the opposite coating of the last jar is grounded. The arrangement gives a very high tension spark. 4. Is there any element that is as strongly diamagnetic as iron is magnetic? I have been told that bismuth, when suspended between the poles of a magnet, tends to arrange itself transversely to the poles of the magnet, and with nearly as much power as iron would tend to arrange itself from pole to pole. Is this true? A. No such element is known; the phenomena of diamagnetism are far weaker in degree than the direct magnetic action (paramagnetic) of a magnet upon iron.

(8) G. F. asks some common sense arrangement for regulating an incubator to keep it any desired temperature, say 103° Fah. A. There is a variety of ways for regulating incubators, many of which are patented. The most simple one, and easiest made by an amateur, is to fasten a strip of hoop iron about one inch wide to a similar strip of sheet zinc of same size, by lightly riveting or only winding with twine. Rivet or solder the ends together solid, or so they cannot slide upon each other. Make the strips somewhat shorter than the distance across the hatching box. Fasten one end at one end of the box near the top, leaving the other end free to move. The changes of temperature will swing the free end to and fro for a short distance, and this can be made to move a delicately hung ventilating shutter or vary the height of the wick in the lamp as desired. If you are ingenious, we think you can figure out the detail yourself.

(9) L. M. asks: How many and what kinds of lenses would be required to make a first class magic lantern, and can as good results be got with polyopticon as with magic lantern? A. For a first class lantern use achromatic lenses, plano-convex, 1¼ to 2 inches diameter and from 8 to 16 inches focallength, according to sizes of pictures to be shown and distance of screen. Also plano-convex condensers, 3 inches to 4 inches diameter, 8 inches to 12 inches focus, placed convex sides together. You may use the same size and focus single plano-convex lenses for a polyopticon, but it does not give as much satisfaction as a well equipped magic lantern.

(10) F. W. S. asks: If the pumps fail to work, the water is low, and you are in danger of being driven on a lee shore, what course would you adopt? and says the question was asked an engineer trying to take out papers in a Western city. A. Such a question can only be answered circumstantially. No sea or lake going steamer should be licensed with but a single means of feeding the boilers. A steam pump and an injector should be provided, as well as hand pump that can be used in case of necessity for the boilers and for clearing the vessel in case of leaks otherwise uncontrollable. When all supplementary means fail, steam until the water reaches the tubes or flues, then shut down, draw fires, and go ashore, if sails cannot save you.

(11) C. A. S. asks how to coat a number of small articles with bronze, by dipping. A. You may make a bronze dip by mixing bronze powder with thin varnish. Thin any ordinary varnish with turpentine, and keep it thoroughly stirred while dipping. A better and brighter bronzing is made by dipping in very thin varnish and allowing it to partially dry, then brushing the work with the dry powder on a fur brush.

(12) J. J. P. asks how gelatinized paper is prepared for performing the experiment of the paper mermaid, described on page 56 of the January 22, 1887, issue of the SCIENTIFIC AMERICAN. A. Dip a piece of tissue paper in a weak solution of gelatine and water, from 4 to 12 grs. to 4 oz. water. When dry, the paper will operate as described.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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AND EACH BEARING THAT DATE.

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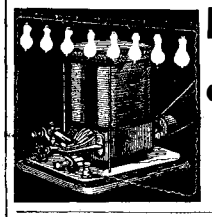
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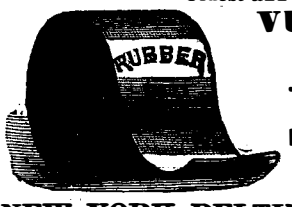

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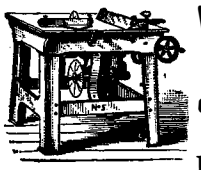

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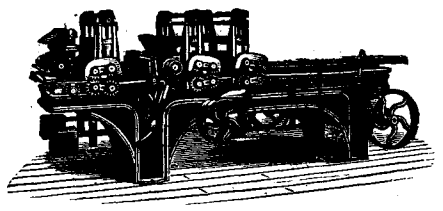

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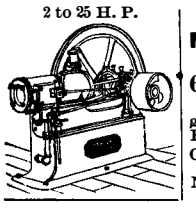

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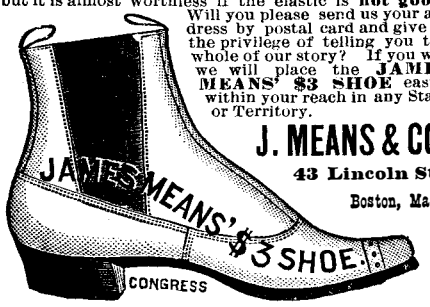

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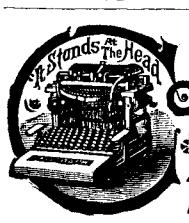

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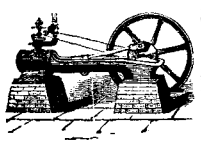

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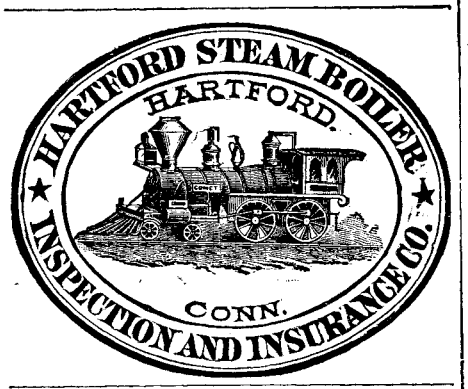

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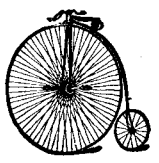

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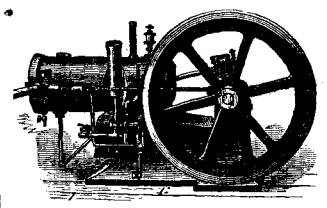

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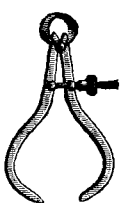

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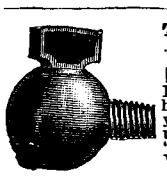

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